SCIENCE

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

CONSERVATION AND SCIENTIFIC FORECAST[1]

By ROBERT CUSHMAN MURPHY

AMERICAN MUSEUM OF NATURAL HISTORY

I

THERE is no denying that it is pleasant to escape now and then from the intimate company of day-by-day colleagues who know one altogether too well, and to fall among such charitable Samaritans as comprise the council, the staff and the membership of your society. On this memorable occasion, I attribute my good fortune entirely to the fact that geographers are the most hospitable of learned men. Some branches of science are, by comparison, highly exclusive and esoteric. To be admitted to the fold a candidate must go through a traditional initiation, and must thereafter hew closely to the line. Not so with geography. If an anthropologist turns his attention to population problems; if a botanist considers the broader aspects of landscape; if an ornithologist endeavors to evaluate factors controlling distribution of life in the sea—it seems that he may have the unexpected reward of being clapped on the back and greeted with the hearty cry, "Man, you're a geographer!" And, to emphasize the welcome, they sometimes give him a gold medal.

I wish that you might all see and feel this beautiful Cullum Medal. It is clear that the designer intended it eventually to go to a student of sea birds, because the obverse shows the figure of a starry-eyed sailor youth, half-clad in ethereal vestments, that would never be approved by any skipper of my acquaintance, standing in the bow of what might be a whaleboat and attempting to put salt on the tail of a gull that is flitting just out of reach. It goes without saying that the medal becomes one of my first treasures. It takes

[1] Address in response to the award of the Cullum Geographical Medal at a meeting of the American Geographical Society, New York, December 20, 1940.

a place among the Penates of the family and, if my two grandsons insist upon rolling it, I'll see that they do so only indoors and on the softest rugs.

I can not help being filled with awe when I contemplate the names of the great souls, thirty-four men and two women, who have received earlier impressions of this medal. They include my boyhood heroes, Fridtjof Nansen and Sir John Murray, as well as others such as Scott, Osborn, the Prince of Monaco and Schokalsky, at whose feet I sat during later years. It would be all too easy to believe that the Cullum Geographical Medal of itself conveys to the recipient a sort of superhuman aura. I shall hasten, however, to check the growth of vanity in that direction by remembering a parchment, received from the hands of the distinguished president of a great university, which states in plain English that the degree endows me forever with certain "rights, privileges and immunities." These I have not yet discovered, particularly the immunities.

II

I am scheduled to fill the preliminary period, between now and the moment when Professor Sauer comes out for the championship bout, by speaking on "Conservation and Scientific Forecast." Let the emphasis be upon the word "scientific," because most prophecies concerning the supply of renewable natural resources have been based upon hopelessly uncritical opinion and have proved correspondingly ill-founded. Dr. Bowman, formerly director of the American Geographical Society, has given us an example of such discrepancy in his review of the oyster industry of Chesapeake Bay.[2]

More than fifty years ago, Professor W. K. Brooks, of the Johns Hopkins University, foretold with astonishing accuracy the decline and fall of the oyster empire of the Chesapeake. In 1890 he published a book that has stood the test of a half century of criticism. His researches had already revealed a 50 per cent. falling off in the Maryland oyster population within the three-year period of 1879–1882, and he boldly predicted what the subsequent course of events would be if the findings of science were ignored. The fatal changes of the next fifty years represent, as Bowman points out, one of the best validations of scientific forecast. The reasons behind the failure were that the political builders rejected the sound foundations of Brooks. Again and again successive state legislatures sought to protect and encourage the industry by consulting so-called "practical" oystermen. In other words, lay opinion, or what we might call a hunch, was substituted for knowledge based on biological data and application of the inductive method.

It would be easy to multiply similar examples from many fields. Lumbermen have hardly proved well justified in their optimism concerning the subsequent quantity and price of marketable board-feet, nor sportsmen regarding the supply of waterfowl and other game, at least in relation to the increasing demand. Ackerman[3] has recently given us an impressive tabulation based on the marine fisheries of New England, which shows that the annual catch of such former staples as salmon, shad, lobster, mackerel and menhaden has fallen off 70 per cent. or more, mostly during the past one or two generations in which the human population has doubled. In 1889, 173,000,000 pounds of menhaden were taken by New England craft; in 1933, the catch was only one million pounds. Such losses are partly masked by better facilities for transporting an equivalent product from a greater distance, but it is certainly true that, despite the varied conservation activities in the six New England states, no broad plan yet exists to take account of the future of commercial fishing. The end, nevertheless, threatens to be similar in kind and even more critical in human economy than the universally mourned extirpation of the passenger pigeon.

Fortunately, it is possible to point to a few happier and more intelligent examples of study and regulation of the sea fisheries, among which the convention between the United States and Canada for the management of North Pacific halibut stands high in admirable conception and effective results.[4] I mention this, however, mainly to call attention to a fact which some American business men find unwelcome. It is this: when matters take a turn for the better, as they have in the halibut fishery, where do the ultimate springs of action prove to lie? With "practical" commercial fishermen? With the hard-headed, substantial citizens whose money is invested in such ventures? Not at all! We can be thankful enough if these gentlemen merely fall in line and lend their cooperation before the time is too late. The call is nearly always sounded, years before action is taken, by the disinterested and allegedly "impractical" man of science. It is very easy to demonstrate that the great industrial and manufacturing concerns have given far more opportunity and credit to research in pure science than have the organized business interests which draw upon the natural wealth of organic resources. Yet the benefits to be derived from the scientific method are probably as great in the one field as in the other.

[2] Isaiah Bowman, *Scientific Monthly*, 50: 289–298, 1940.

[3] E. A. Ackerman, *Economic Geography*, 14: pp. 233–238, 1938.

[4] H. E. Gregory and Kathleen Barnes, "North Pacific Fisheries. Studies of the Pacific," No. 3, American Council Institute of Pacific Relations, 1939.

III

Now scientific forecast can proceed from information of many different kinds, and it may be interesting to point out certain bearings of modern biological investigation upon our outlook in the sphere of conservation. Too often we have made our estimates upon a basis of certain continuing stable rates of plant and animal productivity. The return has in most cases fallen short of the expectation, even when liberal allowance had been made for improved methods of harvesting and the increased demand caused by an expanding population. The chief source of error has lain in the primary assumption: there is probably no such thing as stability in either numbers or productivity of living organisms, because all of them seem to share in the rhythmic fluctuations that are among the most familiar phenomena in our world and in the universe outside it. Recognition of this truth, and the processes that should stem from it, might go far toward enabling us to plan wisely for the future. It would not solve the whole problem, because mankind may perhaps become increasingly faced with the quandary of "scant means in relation to given ends," but it would be likely at least to give us an ameliorating clue, and I shall presently refer to one case in which the principle has already been acknowledged and put to effective commercial purpose.

The changing populations of many kinds of animals and the alternating yield in the seed crop of plants are phenomena that have been observed during a very long period of history. In numerous instances such shifts are not marked by abrupt or startling breaks. Rather, the pendulum of numbers swings gently up and down, the increase and decrease being at comparable rates, neither of which is excessive, so that periodicity over a course of years becomes evident only after a large amount of quantitative evidence has been collected throughout a considerable term. Five years ago, Wing[5] applied such data to a study of common North American insects, fishes, birds and mammals, and demonstrated by means of convincing graphs the regular and repetitive nature of the fluctuations. He correlated his findings with known cycles in the energy output of the sun and even concluded that different species of animals responded to different components of the solar activity.

Here was a discovery of great importance in connection with any attempt to peer into the future. It applied not only to organisms of which man makes direct use, but also to the much larger proportion which influences the stock of something else that he uses. And because of the complex ecological chains in nature, the second category might include nearly every living thing. Insects that fertilize blossoms, for instance, are quite as essential in the scheme as the fruit that follows, or the meat and fur built up in turn from the fruit, with or without intermediate stages. It brings to mind Shelford's[6] comment that it is all very well to protect fishes directly from seiners and birds from gunners, but it is still more urgent to consider what proportion of either will be *breeding* a few years hence.

Wing's investigations comprised, of course, only relatively short climatic rhythms and some of their parallelisms in the world of life. We are acquainted with still briefer organic cycles that run their course within a few days. Still more familiar are the annual cycles. The German South Polar Expedition found, for example, that at Gaussberg the plankton ratio in the sea was in winter (June to December) 1; in January 7; in February 25; in March 50; in April 20; in May 1, or back to the minimum.[7] Such seasonal periodicity is an outstanding phenomenon in the life of polar waters, but we have learned little about whether there is an appreciable variation from year to year.

Elton,[8] who is recognized as one of the foremost students of animal populations, has in various works described many other specific cycles. Thus mice and the foxes that eat them reach maximum density about every 3.6 years. The sugar-cane froghopper of Trinidad has a period of four years; squirrels of 5; hares and arctic foxes of 10 or 11, which also happens to be the same as that of the beech-mast crop in Britain; wild sheep of 20; the cotton-worm moth of the United States 21; African buffalo 30; elephant 50; and so on. In high latitudes the cycles are usually contemporaneous for similar organisms around the world, but in milder zones closely related creatures may exhibit marked discrepancies on different continental areas. Thus Leopold and Ball[9] found that the rhythmic fluctuations of grouse average about 10 years in North America but only six and a half in Great Britain.

Doubtless there are countless other fluctuations of which we yet know nothing but which are attuned with, or enhanced by, the long-term climatic cycles. Many of us used to smile when aged persons remarked that we no longer experienced the cold winters of their childhood. Granddad's old-fashioned winter was the

[5] L. W. Wing, *Transactions Twenty-first American Game Conference*, pp. 345–363, 1935.

[6] V. E. Shelford, "Animal Communities in Temperate America," 1937.

[7] Cited in, Richard Hesse, W. C. Allee and K. P. Schmidt: "Ecological Animal Geography," 1937.

[8] C. E. Elton: *British Journal of Experimental Biology*, 2: 119–163, 1924; "Animal Ecology and Evolution," 1930; *Journal of Hygiene*, 31: 435–546, 1931; "Animal Ecology," 1935; "Evolution" (edited by G. R. de Beer), pp. 127–137, 1938.

[9] Aldo Leopold and J. N. Ball, *Canadian Field-Naturalist*, 45: 162–167, 1931.

slightly derisive term, and it was usually attributed to senility or to the better heating apparatus of our own day. Yet an abundant meteorological record now indicates that the impression is by no means an idle tale. For more than a hundred years, and particularly since the turn of the present century, we have actually witnessed a world-wide trend toward milder climate, which transcends the short-term ups and downs of sunspot cycles.

Now all this may seem somewhat vague data to serve as the foundation of scientific forecasts bearing upon conservation problems. They are, nevertheless, matters about which we urgently need to learn more. They will have to be included in the reckoning before we can begin to figure accurately about the future availability of many kinds of organic products for which we find a use or a dire need. Such foresight might protect us from making the slight overdrafts on natural resources that are different only in degree from the gross overdrafts which we can already see and combat. For whether we use many times too much or only a little too much of the resources we can not create, the result in the long run will be the same, namely, depletion. We are already wise enough to discard as a complete fallacy the argument that a species is in no danger because it is still common.

IV

Better known than the moderate and often obscure types of fluctuation in numbers and productivity are those in which organisms swing through such a wide arc that no observer can fail to be aware of them. These are the spectacular rhythms, in which increase to the point of overpopulation is followed by a rapid and catastrophic die-off, so that for a number of subsequent seasons an area that had swarmed with a particular form of life may seem to be without a trace of it. Always, however, a sufficient nucleus remains to start the upswing of the cycle. It is a remarkable fact that although many large groups of animals approach extinction at regular intervals, they have rarely attained it since the last Ice Age except when man has added the dead weight of his hand to the falling beam of the scales. For as Elton has said, to have the right enemies is a biological advantage, but of all the disasters, including predators, floods, droughts, fires, avalanches and disease, the worst for the flora and fauna of primitive regions is the introduction of civilized European man.

The rhythmic population growths, which are followed by a "boiling over," mass emigration, general mortality and other apparent abnormalities, are characteristic of a great many forms of life both on the land and in the sea. There is now an enormous scientific literature on this subject with which many of you are acquainted. The famous case of the lemmings is known to nearly everybody. An example nearer home is that of the outbursts of tent caterpillars and geometrid moths that appear about once in a decade, defoliate vegetation, and for one or two successive years stir up a furore out of all proportion to their real significance. It is difficult to make people understand that the best thing to do about them is nothing. They carry their own inherent correctives, and there are reasons for believing that they represent biologically beneficent phenomena rather than otherwise. At any rate, they are followed by longer periods during which scarcely enough of the supposedly objectionable insects remain to remind us of their existence. The end of a so-called plague of native insects or rodents is rarely due to human effort or the money spent; it is usually merely the natural conclusion of the cycle.

Green and Evans[10] have given us only this year a statistical picture of a portion of the well-known snowshoe hare cycle of northern North America. They report that in the Lake Alexander area, Minnesota, these rodents reached in 1933 a maximum population of close to 500 hares per square mile. During the next two years there was a moderate decline. This was followed between 1935 and 1938 by the anticipated cataclysmic drop, until the population was only about 10 per cent. of the peak number. Recovery then began, and in 1939 it had about doubled the numbers of 1938.

The observations of Hewitt, Cabot, MacFarlane, Preble, Seton and others[11] on this general subject have been greatly extended by Elton. The long records of collection and sale of furs by the Hudson's Bay Company have proved a mine of priceless information for revealing plant and animal fluctuations in relation to climatic influences over more than a century. They have also enabled us to predict with considerable confidence the course of future events. Elton has assembled scattered historical references which help to trace the system back as far as the thirteenth century and, indeed, even far beyond that date to the occasion on which a great swarm of field mice ate the bowstrings of Sennacherib's army, when "the Assyrian came down like a wolf on the fold." It has been made easy for us to see that organisms that subsist principally upon the "interest" of plant and animal productivity, such as mice, rabbits, foxes and lynxes, show the sharpest periodicity. The beaver, on the other hand, which has few predatory enemies, and which eats bark and therefore lives on "capital" rather than interest, does not harmonize with the others; its fluctuations depend rather upon the man-made pressure

[10] R. G. Green and C. A. Evans, *Journal of Wildlife Management*, 4: 220–238, 1940.

[11] All cited in, C. G. Hewitt, "The Conservation of the Wild Life of Canada," 1921.

of trapping and the long-term changes in the water table. The curves based upon Hudson's Bay Company pelts also enable us to distinguish between scarcity due to persistent over-destruction by man and the purely temporary scarcity that results from a "crash" in the normal cycle of variability. Among the fur-bearers of Canada, for instance, the lynx and fox still exhibit the traditional cycles; but the marten, which has the extraordinarily long gestation period of nearly ten months, has been so heavily overtrapped that it is no longer able to increase rapidly in numbers at rhythmic intervals, as it formerly did.

We can do no better than to draw a moral from the customs of primitive peoples, who are almost never exterminators. It is known that in good years many mammals double the size of their poor-year broods. The Indians in western Canada count the embryos in the bodies of hares in order to obtain a clue to next year's rabbit crop. Civilized man now has plentiful data to justify him in looking much farther ahead and to comprehend the prospect for a broad range of natural resources. But he must remember that he is never dealing with discrete numbers or events, but rather with rates of waxing and waning. He must think not in terms of fixed but of constantly varying supply, and must regulate utilization of raw material according to a system of control that fluctuates no less than the natural cycles are bound to fluctuate. As long as the capital of animal numbers is destroyed to make the fortunes of a few men, the income that should accrue to future generations will be forfeited.

In short, we need to know much more than the current rate of exploitation in relation to supply, regardless of whether the latter at the moment seems to be decreasing, increasing or standing still. Petersen,[12] who has investigated the effect of fishing upon the stock of plaice in the Baltic, shows that between 1919 and 1924 the annual yield fell progressively from 2,997 to 1,280 tons. This has a highly familiar ring; the plaice, like so many other marine foodstuffs, were being overfished. But the author adds almost casually that the age of plaice has been determined to extend to 17 years, and that there is a long interval between years of plentiful fry. The last statement no doubt contains the kernel of the problem. You can't hope to regulate plaice fishing profitably until the cycle of the species has been worked out.

Variations in the supply of many other fishes, such as our own Atlantic haddock, are by no means entirely dependent upon the extent of market fishing. This was strikingly shown in a paper by Dr. Columbus Iselin, director of the Woods Hole Oceanographic Institution, given within the past fortnight before the New York Academy of Sciences. He reported that the strength of the Gulf Stream current varies about 15 per cent. from month to month, and that the pulsations are clearly correlated with tidal amplitudes along the Atlantic coast of the southern United States. At certain seasons the rhythms in the strength of the Gulf Stream are sufficient to form marginal eddies that suck most of the normal water off George's Bank, and thus drag the haddock fry into depths of 2,000 fathoms, instead of their customary 30 fathoms, resulting in the dispersal and loss of the whole generation. Forecasts of such calamities can be deduced from the tide gauges at Charleston and Miami, and such data will therefore have to be applied to any sound and lasting regulation of our local haddock fishery.

[12] C. G. J. Petersen, *Report of the Danish Biological Station*, 31: 7–11, 1925.

V

Now we can all imagine, for the moment, a future in which the conception of steadily maintained returns from natural resources will be entirely eliminated from the point of view of the industries concerned and of the general public. Certain minor steps in this direction have already been taker. Shooting laws covering migratory waterfowl, for instance, are no longer reprinted as a matter of course from last year's texts. On the contrary, the President of the United States now issues an annual decree based upon a report on the contemporary status of the ducks and geese, derived by scientific methods and with more or less accuracy by the Fish and Wildlife Service. The most exemplary and hopeful change in popular response that could take place would be a cheerful acceptance of the mandate, instead of a howl of protest whenever the laws are tightened instead of liberalized. Since self-interest controls the decision, we should at least be able to accept it as calmly as a patient takes his prescribed diet. A gradual educational process may yet, however, pave the way for announcements that will some day refer to the probable Atlantic-coast oyster regulations twenty years in advance! Such distant forecasts would be the only means of preparing us for painless adjustment of our plans.

Now you may say that I have outlined a pretty prospect without offering any decent suggestions as to how it may come into being against the terrible force of prejudice and inertia. My answer is that in one part of the world the reality has been attained, and it works. The realm is that of the guano islands off the desert coast of Peru.

The history of Peruvian guano is the usual one of discovery, greed, erring faith in the inexhaustibility of free treasure, and then ruin; but, happily, the sequence can in this instance be continued through to a revival, due to the application of scientific principles while there was still time. The restoration of the

Peruvian guano industry or, rather, its conversion from a purely destructive exploitation into a true and lasting industry, represents one of the greatest examples of practical conservation that the world has yet seen.

On the biological side, the story is equally interesting and even more complicated. It involves a long, interacting series of cosmic phenomena, including the varying heat given off by the sun, the wind systems of the region, the circulation in the eastern part of the South Pacific Ocean and the maintenance of extraordinarily low water temperatures in tropical latitudes. On such foundations depends the existence of a teeming microscopic plant life which is the pasture of the sea. This in turn supports directly or indirectly the higher and larger living organisms, all the way from crustaceans and small fishes up to birds, seals and whales. There is no other littoral region where birds can be found in such overwhelming abundance. There is likewise no region in which wild birds, requiring no human care other than to be left sufficiently alone, are so closely associated in the popular mind with direct economic benefits to man himself. This also is true; guano is a commodity of commerce, worth millions of dollars annually to those who control its production and those who purchase it for the enrichment of their crops.

Birds of the present sorts, or birds which filled a similar ecologic niche, have probably occupied this coast for millions of years, or ever since the uplift of the Andes first established the fundamental geographic conditions that have continued to the present. Throughout short periods of years their numbers expand prodigiously, as a result of the bounty and surplus of food in the coastwise, northward-moving Humboldt Current. But at certain periods the oceanic circulation abruptly changes; warm surface water from the outlying tropical ocean flows toward the coast; conditions of life suddenly become unfavorable for the marine pasture, and the whole pyramided structure begins to topple like a house of cards. Dead fish line the beaches and the stench is carried miles inland. The birds, too, perish in quantities not to be measured by concrete numbers but rather by the hundreds of miles of their strewn corpses along the tide line. Their death is not usually due to starvation but to shock-disease and other maladies that overtake animals whose vitality has been sapped by the knocking from beneath their feet of the whole complex system upon which healthy existence depends.

On the west coast of South America the cycle, thus briefly described, appears to be one with a periodicity of about seven years. Some of the manifestations are much more severe than others, and there are indications of cycles within cycles, culminating at times in such extreme conditions as those of the early months of 1925. In any event, there is likely to be a gradual build-up during seven years toward a peak of population, to be followed successively by a more or less widespread dying-off, a period of readjustment and then a renewal of the upswing. A graph of the production of Peruvian guano during a long course of years shows very clearly the alternating peaks and depressions which are an index of the varying population of birds.

Between 1840 and the beginning of the present century, man aggravated the periodic reductions in population and hindered the recoveries. The birds were regarded not as everlasting capital but as a nuisance and an encumbrance on the thick and "inexhaustible" beds of fertilizer that their ancestors had laid down throughout thousands of years. By the time the last cargo of ancient guano had been transported from these islands, the future looked dark indeed for a country which required at least 70,000 tons a year to support its own essential agriculture.

But in due course it came to be realized in Peru that if the heedless human animal could act so adversely upon the world of life, not to mention his own interests, it should be equally plausible that by using his brain he might be able to bring himself into harmony with nature. That, fortunately, is what has been ultimately accomplished along the guano coast. In the present century the sea bird is king; it has been literally recognized as the goose that lays the golden egg. Out of the wreck of the past, a great civilized and beneficent system has evolved. The guano islands are now, first of all, bird sanctuaries, and by far the most impressive sanctuaries of their kind to be found anywhere on the face of the globe. Increase of a commercial product is their underlying object, but the crop removed in any one season is not allowed to exceed the limitations imposed by nature. The long view takes precedence over the immediate demand. It is fully realized that the guano output can never be expected to be equal each year, that operations must permanently be attuned to the seven-year periods, and that a watchful eye must always be kept upon exceptional circumstances affecting the wanderings and reproductive capacity of the sea fowl. In other words, the bird itself—the producer—has at last become the determiner of what man shall undertake. Human intelligence is now directed toward ameliorating the periodic and inevitable falling of the scales; human intelligence likewise endeavors to heighten the population peaks that as surely follow. By means of blasting and grading, the area of windward slopes on the islands, which are best suited to support dense aggregations of nesting birds, are being gradually increased. Wise laws, based upon fundamental ecological research, not only guard the birds themselves but also

prevent any undue human competition for their food resources in the coastal ocean. The average yield of fertilizer, as figured by seven-year terms, has grown phenomenally during the past thirty years, yet it is believed that the maximum capacity of the islands still lies far ahead.

Here, at any rate, is one part of the world in which native wildlife will remain secure as long as such wisdom prevails. Here is scientific forecast in pragmatic operation. Here is a case in which a South American republic holds up a beacon for all other nations to admire and emulate.

TOWARDS A NEW BIOCHEMISTRY?[1]

By Professor A. SZENT-GYÖRGYI

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THE atom consists of a nucleus surrounded by a system of electrons. By sharing one or more electrons, atoms can join to form molecules. In such a molecule, as a rule, every electron belongs to one or two atoms. This is our idea of a single small molecule, and this picture has hitherto unconsciously governed our thinking in biochemistry.

The study of crystals and metals, however, has revealed the existence of a different state of matter. If a great number of atoms is arranged with regularity in close proximity, as for instance, in a crystal lattice, the terms of the single valency electrons may fuse into common bands. The electrons in this band cease to belong to one or two atoms only, and belong to the whole system.

These bands or energy levels are separated from possibly higher levels by forbidden zones. Under ordinary conditions all electrons are within the lowest band. If this lowest band contains the maximum number of electrons ($2n$, if the number of atoms is n), as is the case with insulators, the electrons will be unable to transport energy. If, however, one of these electrons is raised by the absorption of energy to a higher level, and comes to be in what we call an excited state, where it will move and transport its energy freely, it will be impossible to say which is the atom to which the excited electron belongs, and the whole system can be looked upon as activated. By falling back to the lower level the electron will give off its excess energy and perform work in a place more or less distant from that of the absorption of energy. This is the case with certain phosphors, as has been shown lately by N. Riehl.[2] Here, as for instance in ZnS, the electron, raised to a higher level by a collision with an α particle, can travel relatively long distances and will fall back to a lower level, giving up its energy, where it meets a Cu atom, present as an impurity. Thus the absorption and emission of energy will proceed independently at different places.

The problem is whether this state of matter, *i.e.*, common energy levels, exists also in living systems. If it does it can not fail to influence profoundly our biological thinking and open new approaches to research and understanding. Protein molecules are systems built up of a great number of atoms, closely packed with great regularity. So theoretically the possibility exists that within these molecules analogous conditions to those in crystals prevail.

The first indication of the existence of such common energy levels was given by the study of photosynthesis, one of the most fundamental biological processes. Emerson and Arnold[3] found that 2,500 chlorophyl molecules form one functional unit. Warburg and Negelein[4] showed that four quanta are necessary for the reduction of one CO_2 molecule. There are observations to indicate that these four quanta must reach the CO_2 molecule simultaneously. Gaffron and Wohl[5] calculated how many chlorophyl molecules must interact to absorb four quanta simultaneously at the weakest optimal illumination. Their calculation showed that only one thousand molecules are capable of doing this. These observations indicate that the electrons, raised to a higher energy level by the absorbed light, can move and transport their energy freely through the system of chlorophyl molecules.

Kubowitz and Haas[6] have measured the inactivation-spectrum of urease, and P. Jordan[7] has pointed out that their results are in agreement with the idea that common energy levels exist within this protein molecule. At present K. Laki and M. Gerendás are engaged in my laboratory in the study of the inactivation-spectrum of fumarase, crystallized by Laki. Their results also indicate that the energy absorbed may leave the place of its absorption and cause a break of links at a different place, thus traveling at some distance through the molecule.[8]

[1] Korányi Memorial Lecture, given in Budapest on March 21, 1941.

[2] N. Riehl, *Naturwiss.*, 28: 601, 1940.

[3] R. Emerson and W. Arnold, *Jour. gen. Physiol.*, 16: 191, 1930.

[4] O. Warburg and E. Negelein, *Naturwiss.*, 13: 985, 1925.

[5] H. Gaffron and K. Wohl, *Naturwiss.*, 24: 81, 1936.

[6] F. Kubowitz and E. Haas, *Biochem. Zeits.*, 257: 337, 1933.

[7] P. Jordan, *Naturwiss.*, 42: 693, 1938.

The more interesting question, however, is not whether common energy levels exist within one molecule, but whether protein molecules can join into more extended systems with common energy levels. It would be difficult to picture such a continuum built up of globular protein molecules, and protein molecules have hitherto, with rare exceptions, been found to be globular. However, last year Banga and I[9] found that the proteins building up the solid structure of the cell are fibrous, and that these fibrous molecules as shown by their strong thixotropy, are interconnected by intermolecular forces. Chloroplasts also contain fibrous proteins.

This finding allows us to suppose tentatively that a greater number of molecules may join to form such energy continua, along which energy, *viz.*, excited electrons, may travel a certain distance. The study of gene-mutation, introduced by x-rays and ultraviolet light, also indicates such a possibility.

It can not be expected that any single observation will definitely solve this problem. Only the accumulation of a great mass of data will answer these questions. But even at this early stage we are justified in reconsidering the biological problems in the light of these possibilities.

My own biochemical research of two decades has yielded one or another insignificant result—the isolation of this or that—but whenever I was faced with a fundamental problem, I failed. When these problems are reconsidered in the light of common energy levels an easy explanation offers itself. I will enumerate a few of these problems starting with one which arose lately in collaboration with Banga.[9]

The contractile element in muscle is myosine, a protein built up of fibrous molecules. These molecules are arranged in small, primitive bundles. A great number of such primitive bundles forms one microscopic fibril. The energy of muscular contraction is derived from the splitting of adenosine triphosphate. The adenosinetriphosphatase activity is bound up with myosine, but our measurements indicate that only a very small fraction of myosine molecules can be endowed with such activity. The problem is, how the energy liberated by a molecule can be communicated to a great number of similar molecules. The common energy levels give an easy answer.

Another problem that troubled me for many years was why the enzymes involved in oxidation and fermentation can be separated so sharply into soluble and insoluble ones. The enzymes involved in lactic fermentation of muscle are soluble, while the enzymes involved in oxidation are insoluble, *i.e.*, bound to the insoluble fibrous proteins of the cell. This difference can be explained if we suppose that the latter are part of a system with common energy levels. In lactic fermentation no such common levels are necessary, for the single enzymes do not interact but react in series with soluble molecules.

Still another problem, closely connected with the former, is how the enzymes of oxidation interact. In part of the oxidation system electrons wander directly from enzyme to enzyme. The enzymes, being insoluble, have no free molecular motion and must be arranged so that their small reactive groups are at atomic distances. It is possible to arrange two large protein molecules in such a way, but it is geometrically impossible to so arrange a whole series. Even if we could devise such an arrangement, it would still be incomprehensible how the energy liberated by the passing of an electron from one substance to the other, *viz.*, from one Fe atom to the other, could do anything useful. All this can be understood if we suppose that the single catalysts are connected with different, distinct energy levels and that the electrons do not pass directly from one substance to the other but travel within the corresponding energy band, and can fall to a lower level and give off energy only at a place where they can do work (*e.g.*, a synthesis), analogous to the ZnS phosphors of Riehl. If the cell and with it the energy levels are disturbed in some way, we can expect the electrons to fall freely to lower levels at any place. This might explain why catabolic processes prevail over anabolic ones in damaged tissues (and cancer?), why certain oxidations (catecholoxidase) are activated by damage, why chloroplasts refuse to build up carbohydrates, and why viruses refuse to multiply outside the cell.

In closing, I wish to mention three problems from outside the field of my own work. One of my difficulties with protein chemistry was that I could not imagine how such a protein molecule can "live." Even the most involved protein structural formula looks "stupid," if I may say so. If the atomic structure is only the backbone underlying the common energy levels, the thing becomes more likely. It is equally difficult to understand the great biological activity of certain molecules. R. Kuhn, F. Moewus and D. Jerchel[10] have shown lately that one single crocin molecule is capable of inducing a sexual change in a whole alga. If the cell forms an energy continuum, any substance, approaching at any point, can upset the whole system, making, so to say, a hole in the continuum.

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[8] If common energy levels are present in native protein molecules this can not fail to contribute to the stability of the molecule and influence its immunological behavior.

[9] J. Banga and A. Szent-Györgyi, SCIENCE, 92: 514, 1940; *Enzymologia*, 9: 111, 1940.

[10] R. Kuhn, F. Moewus and D. Jerchel, *Ber. d. Chem. Ges.*, 71: 1541, 1938.

Then we do not know what a "cell" really means, or why the kidney, for instance, is subdivided into such units. Possibly the cell wall is the border line of the common energy levels.

Biochemistry is, at present, in a peculiar state. By means of our active substances we can produce the most astounding biological reactions, but we fail wherever a real explanation of molecular mechanisms is wanted. It looks as if some basic fact about life were still missing, without which any real understanding is impossible. It may be that the knowledge of common energy levels will start a new period in biochemistry, taking this science into the realm of quantum-mechanics.

SCIENTIFIC EVENTS

FELLOWSHIPS OF THE LALOR FOUNDATION

THE Board of Trustees of the Lalor Foundation announced on May 19 the following fellowship awards in chemical and biochemical research for the academic year 1941–42:

$2,000 to Frederick W. Barnes, Jr., to work at Columbia University under Dr. Hans T. Clarke on the investigation of intermediary metabolism with the aid of isotopes.

$2,500 to A. Calvin Bratton, to continue work at the Johns Hopkins University Medical School under Dr. E. K. Marshall on chemical aspects of chemotherapy of compounds of the sulfanilamide type. (This award is for $1,250 per year for a period of 2 years, namely, for 1941–42 and 1942–43.)

$2,000 to Robert B. Carlin, to work at the University of Illinois under Dr. Roger Adams on the determination of the structure of the alkaloid extracted from Crotalaria spectabilis and of analogous alkaloids from various Senecio species.

$2,000 to William W. Rice, to work at Harvard University under Dr. A. B. Lamb on a theoretical and experimental investigation on the adsorption of gases on various materials.

These appointees were selected from a group of approximately thirty qualified applicants.

Including the present appointments there have been thirty fellowship awards granted since the organization of the foundation in 1935 amounting to an aggregate of $63,500.

Appointments to two awards allotted, respectively, to the administration of Dr. F. G. Keyes, of the Massachusetts Institute of Technology, and Dr. Charles A. Kraus, of Brown University, were deferred until conclusion of the special work they are carrying on for the United States Government and until such time as their regular research can again be taken up.

The trustees of the Lalor Foundation, which is maintained through funds contributed by members of the Lalor family, are Dr. Anna Lalor Burdick, of Washington, D. C., Elwyn Evans, John P. Nields, Charles Lee Reese, Jr., Dr. A. R. Shands and C. Lalor Burdick, of Wilmington, and Dallas S. Townsend, of New York City.

THE ENGINEERS COUNCIL FOR PROFESSIONAL DEVELOPMENT

THE eighth annual report of the Engineers Council for Professional Development has appeared. Listed in this report are the one hundred and twenty-five institutions in the United States (and Alaska) that have been accredited by the council.

John P. H. Perry, of New York City, chairman of the Council, records the affiliation of the Engineering Institute of Canada, in October, 1940. He reports also the petition from a group of technical institutes that some such plan of accrediting be evolved for the technical institutes of the country, thus giving more effective recognition to their sphere in technical education.

The Committee on Student Selection and Guidance, of which Dean Emeritus R. L. Sackett, of Pennsylvania State College, is chairman, reports further progress in the study of aptitude tests and, especially, advance in the promotion of proper selection of engineering as a career by high-school boys. It contains excerpts from summaries of activities submitted by local groups of engineers, in New York, Omaha, Detroit, Iowa and Canada, whose aim was not to recruit to engineering, but to give boys of high-school age an opportunity to learn the qualities and aptitudes essential to success. Thus, those with decided engineering talent will continue in this field while those without sufficient aptitude will not undertake a career in engineering should they be more likely to succeed elsewhere.

Dean A. A. Potter, of Purdue University, for the Committee on Engineering Schools, discusses the problems of accrediting and gives statistics on the subject since the initiation of the accrediting program. Included with this report is the latest list of accredited engineering curricula.

The Committee on Professional Training, Dean O. W. Eshbach, of Northwestern University, chairman, reports further efforts to discover what is being done by and for junior engineers in their immediate post-graduation period, and includes as an appendix a questionnaire used to gather information on this subject. This will be used as the basis of a program to be developed for use among the various organizations.

The Committee on Professional Recognition, Professor Emeritus Charles F. Scott of Yale University, *chairman,* discusses the matter of engineering as a profession, and an appreciation of it as such. He strongly urges the various constituent organizations of the council to encourage emphasis on ethics, the teaching of ethics, and the professional spirit among engineering students, in order that they may acquire a full conception of the profession as early as possible.

The Engineering Council for Professional Development, which was founded in 1932, is an organization representing the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Chemical Engineers, the Society for the Promotion of Engineering Education, the National Council of State Boards of Engineering Examiners and the Engineering Institute of Canada. Its purpose is to enhance the professional status of the engineer.

PROMOTIONS AND NEW APPOINTMENTS AT THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE Board of Scientific Directors of the Rockefeller Institute for Medical Research announces the following appointments and promotions on the Scientific Staff to take effect on or after July 1.

Promotions: Associate Member to Member, Dr. René J. Dubos, Dr. Rafael Lorente de Nó.

Assistant to Associate, Dr. Lindsay M. Black, Dr. Jorge Casals-Ariet, Dr. Max A. Lauffer, Jr., Dr. David P. C. Lloyd.

Fellow to Assistant, Dr. James A. Baker, Dr. Paul B. Hamilton, Dr. Margaret R. McDonald.

New Appointments, Member, Dr. Frank L. Horsfall, Jr.

Assistants, Dr. Frederik B. Bang, Dr. Vincent P. Dole, Jr., Dr. George H. Hogeboom, Dr. Robert E. Shank.

Fellows, Dr. Robert A. Phillips, Dr. Sidney Rothbard.

Dr. Robert F. Watson has been appointed resident physician at the hospital.

HONORARY DEGREES CONFERRED BY PRINCETON UNIVERSITY

AMONG the honorary degrees conferred at the one hundred and ninety-fourth commencement of Princeton University were the degree of doctor of engineering on Dr. Harvey Clayton Rentschler; the degree of doctor of science on Professor Leonard Eugene Dickson, and the degree of doctor of laws on Professor Wesley Clair Mitchell.

In presenting the recipients, Professor Eisenhart gave the following citations:

Harvey Clayton Rentschler, director of the research laboratory of the Westinghouse lamp division; a Bachelor of Arts of Princeton and of the class of '03 and a Doctor of Philosophy in Physics of the Johns Hopkins University; after teaching at Princeton and the University of Missouri, he joined the staff of the laboratory of which he is now director, and for a quarter of a century has applied his talents to the investigation of photoelectric cells and of x-ray and electron tubes, which he has developed for commercial use. A brilliant and persistent seeker after nature's secrets, with a generosity toward his collaborators which wins their confidence and their cooperation, he has utilized for the welfare of others the knowledge which he has discovered.

Leonard Eugene Dickson, professor of mathematics emeritus of the University of Chicago; a graduate of the University of Texas and one of the first doctors of philosophy of the Department of Mathematics of the University of Chicago which set the high standard for the subsequent development of mathematical research in this country; a member of the National Academy of Sciences and corresponding member of the Academy of Sciences of the Institute of France; author of hundreds of papers in algebra, writer of many books for college students and research workers, chief of which is his three-volume "History of the Theory of Numbers." The leading American algebraist, whose researches have added much to the knowledge of his field, the inspirer and counselor of a host of young mathematicians, a historian of science whose writings are notable for their clarity and exact expression, for conciseness without loss of completeness.

Wesley Clair Mitchell, professor of economics in Columbia University and director of the National Bureau of Economic Research; a native of Illinois and graduate of the University of Chicago during its early years; deeply interested and competent in the formulation of policies of research leading to a more orderly functioning of the national economy, he has been chief of the Price Section of the War Industries Board, chairman of the President's Research Committee on Social Trends, member of the National Planning Board of the Federal Emergency Administration of Public Works and of the National Resources Board; past-president of the American Statistical and Economic Associations and the Association for the Advancement of Science. Distinguished analyzer of the economic and social order with the phases of business cycles as guiding factor, a kindly and incisive critic, with singular objectivity in his approach to problems of group behavior, a widely sought public servant.

HONORARY DEGREES CONFERRED BY YALE UNIVERSITY

HONORARY degrees were conferred on June 18 at the commencement exercises of Yale University on Dr. Thomas Francis and on Dr. Henry Bryant Bigelow. The remarks were made by the public orator, Dr. Arnold Whitridge, professor of history, arts and letters and master of Calhoun College, and the citations by Dr. Charles Seymour, president of the university. Dr. Whitridge, a grandson of Matthew Arnold, succeeded this year Dr. William Lyon Phelps, who has been public orator at the university for more than twenty years.

The degrees were presented as follows:

Thomas Francis, of the New York University College of Medicine.

Dr. Whitridge:

Mr. President, I have the honor to present for the degree of Master of Science Thomas Francis. A graduate of Allegheny College and the Yale Medical School, Dr. Francis is now professor of bacteriology in the New York University College of Medicine. But New York is going to lose him, for he has just been called to the University of Michigan, where he has been appointed professor of epidemiology and chairman of the Department in the School of Public Health. He was chosen to fill this post on the strength of his invaluable research in the field of infectious diseases. During the last seven years he has devoted himself to the study of influenza, and he is to-day one of our leading authorities upon this scourge. Influenza was originally ascribed to the influence of the stars, but Dr. Francis has exonerated the stars and fixed upon a peculiarly elusive and malignant virus as the real culprit. He was the first man in America to isolate the virus of influenza. This was an achievement of signal importance as it points the way to preventive vaccination and immunity. Young as he is, Dr. Francis has already proved himself a benefactor of mankind.

President Seymour:

Already a master in your chosen field of scientific research, a field the development of which you have directed in the interest of human welfare. Your university confers upon you the degree of Master of Science and admits you to all its rights and privileges.

Henry Bryant Bigelow, of the Museum of Comparative Zoology, Harvard University.

Dr. Whitridge:

Mr. President, I have the honor to present for the degree of Doctor of Science Henry Bryant Bigelow, pioneer in the science of oceanography. At an early age Dr. Bigelow succumbed irretrievably to the lure of the sea. Starting at Harvard as a marine zoologist, he soon became interested in the physics and chemistry of the sea itself and began his researches in oceanography as it is at present understood long before such investigations had been undertaken by any other individual or institution in the United States. Many of the activities of the United States Coast Guard, particularly the services of the Ice Patrol in forecasting iceberg conditions, may be credited to his initiative. During the last ten years he has guided the development and progress of the Woods Hole Oceanographic Institution to a leading position in the world of marine research. More than most men who go down to the sea in ships, Dr. Bigelow has seen the works of the Lord and His wonders in the deep, and he has recorded his observations, as the Psalmist would have approved, for the lasting benefit of his fellow men.

President Seymour:

Scholar and benefactor of mankind, for your studies that resulted in the protection of ships and men from the menace of ice and in the protection of the fisheries, as well as for your guidance of young scientists in the field you have made yours, Yale University confers upon you the degree of Doctor of Science and admits you to all its rights and privileges.

ELECTIONS TO FELLOWSHIP IN THE ROYAL SOCIETY, LONDON

AT a meeting of the Royal Society held on May 29 the following were elected to the Foreign Membership of the society:

Dr. James Bryant Conant: president of Harvard University. Distinguished for his researches in organic chemistry and the application of physical methods to the elucidation of the mechanism of organic reactions: also distinguished for researches in biochemistry.

Dr. Karl Landsteiner: member in pathology at the Rockefeller Institute for Medical Research, New York. Distinguished for his work on immuno-chemistry which has established the dependence of the specificity of the antigen-antibody reactions on known chemical structures.

Under a statute of the Royal Society which provides for the election of persons who either have rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the society, the Right Honorable Winston S. Churchill was elected a fellow.

DEATHS AND MEMORIALS

DR. MEYER BODANSKY, professor of chemistry in the department of public health and preventive medicine, Medical School, University of Texas, and director of Clinical Laboratories of the John Sealy Hospital and the John Sealy Memorial Research Laboratory, Galveston, Texas, died on June 14. He was forty-four years of age.

DR. ERNST TH. VON BRÜCKE died suddenly on June 12 in his sixty-first year. At the time of his death he was research associate at the Harvard Medical School. He was formerly professor of physiology at Innsbrück and was forced to retire from his professorship in 1938.

PROFESSOR FRANCES GERTRUDE WICK, chairman of the department of physics at Vassar College, with which she had been associated since 1910, died on June 15 at the age of sixty-five years.

A TABLET was unveiled on June 8 in the Sanders Laboratory of Chemistry at Vassar College in memory of Dr. Charles William Moulton, who taught chemistry there from 1892 to 1924, by his granddaughter Katherine Moulton, a sophomore. Dr. Henry Noble MacCracken, president of the college, paid tribute to Dr. Moulton.

SCIENTIFIC NOTES AND NEWS

THE American Association for the Advancement of Science and a number of affiliated and associated societies have been meeting this week at Durham, N. H., in connection with the celebration of the seventy-fifth anniversary of the University of New Hampshire. An account of the meeting by the permanent secretary of the association will appear in an early issue of SCIENCE.

AT the Harvard University commencement in June the honorary doctorate of science was conferred on Dr. Ernest O. Lawrence, professor of physics and director of the Radiation Laboratory of the University of California, and on Dr. Vannevar Bush, president of Carnegie Institution of Washington, chairman of the National Defense Research Committee.

THE doctorate of science was conferred at the one hundred and seventy-third commencement of Brown University on Robert Cushman Murphy, curator of oceanic birds at the American Museum of Natural History, New York, and on Glenn Luther Martin, president of the Glenn L. Martin Company, airplane manufacturers.

THE University of Pennsylvania has conferred the degree of doctor of science on Dr. John J. Shaw, secretary of health for Pennsylvania, and on Dr. Richard Wilson, of Havana, prominent in public health work in Cuba.

AT the annual commencement on June 14 of the Michigan State College of Agriculture the honorary degree of doctor of science was conferred on Dr. Truman G. Yuncker, head of the department of botany at DePauw University, in recognition of his contributions to the knowledge of the genera Cuscuta and Peperomia as well as of his contributions to the flora of the Pacific Islands and Central America. Dr. Yuncker is a graduate of the college.

THE doctorate of science was conferred on June 16 by Smith College on Justina H. Hill, bacteriologist, instructor in urology in the School of Medicine of the Johns Hopkins University.

DR. BEDELL, emeritus professor of ophthalmology at the Albany Medical College, received the honorary degree of doctor of science from Hobart College, Geneva, N. Y., at the commencement of the college on May 26. He also received the doctorate of science from the University of Colorado on June 9.

AT the annual dinner meeting on June 25, at Knoxville, Tenn., of the American Society of Agricultural Engineers the Cyrus Hall McCormick gold medal was presented to H. C. Merritt, vice-president of the Allis-Chalmers Manufacturing Company, Milwaukee, for "exceptional and meritorious engineering achievement in agriculture," and the John Deere Gold Medal for "distinguished achievement in the application of science and art to the soil" to R. W. Trullinger, assistant chief of the Office of Experiment Stations of the U. S. Department of Agriculture. E. E. Brackett, professor and head of the department of agricultural engineering of the University of Nebraska, and retiring president of the society, presented the awards.

DR. WALTER B. LANCASTER, professor of ophthalmology and chief of staff of the Clinical Division of the Dartmouth Eye Institute, received the Howe Research Medal in Cleveland on June 6. The award of the medal, which has not been given since 1938, is made by the executive committee of the Section of Ophthalmology of the American Medical Association "to any person in any country whose researches in ophthalmology or any of the allied branches of surgery have proved to be of distinguished merit."

THE Sir John Kennedy Medal of the Engineering Institute of Canada has been awarded to Lieutenant-General A. G. L. McNaughton, commander of the Canadian Corps in Great Britain, past president of the National Research Council of Canada.

AT the annual meeting of the Board of Trustees of the Maryland Academy of Sciences the following officers were elected for the year 1941 to 1942: *Chairman of the Board of Trustees,* Dr. Herbert A. Wagner; *President,* Dr. Sebastian Karrer; *Director,* Dr. J. Wallace Page; *Treasurer,* William J. Casey; *Assistant-treasurer,* Harry A. Sharrett; *Secretary,* John C. Paterson.

OFFICERS of the Purdue Branch of the American Association of Scientific Workers have been elected as follows: *President,* Professor K. Lark-Horovitz; *Vice-president,* Professor H. B. Hass; *Secretary,* Professor Harriet E. O'Shea; *Treasurer,* Professor C. C. Roys; *Members-at-Large of the Executive Committee,* Professor A. I. May, Professor G. S. Meikle and Professor R. B. Withrow.

AT the ninety-seventh annual meeting of the American Psychiatric Association, held at Richmond from May 5 to 9, the following officers were elected: *President,* Dr. James K. Hall, Westbrook Sanitarium, Richmond, Va.; *President-elect,* Dr. Arthur H. Ruggles, Butler Hospital, Providence, R. I.; *Secretary-treasurer,* Dr. Winfred Overholser, Saint Elizabeths Hospital, Washington, D. C.

DR. LEWIS J. POLLOCK, professor of neurology and mental diseases at the Medical School of Northwestern University, was elected on June 11 *president* of the American Neurological Association at the meeting of

the association held at Atlantic City. Dr. Edward A. Strecker, of Philadelphia, was elected *first vice-president* and Dr. Abraham Myerson, of Boston, *second vice-president*.

DR. CHARLES N. FREY, director of the Fleischmann Laboratories, Standard Brands, Inc., New York, was elected president of the American Association of Cereal Chemists at the annual meeting held at Omaha from May 19 to 24.

DR. JEAN PERRIN, French physicist and Nobel laureate, has been invited to become visiting lecturer at Wilson College, Chambersburg, Pa., during the academic year 1941–42 under a fund contributed by faculty staff and college.

DR. EUGENE F. DUBOIS has been made professor of physiology and head of the department of biochemistry and physiology at the Cornell University College of Medicine. He is succeeded as professor of medicine and physician-in-chief of the New York Hospital by Dr. David Presswick Barr, professor of medicine at Washington University, St. Louis, and physician-in-chief of Barnes Hospital. As already announced, Dr. William Dock, professor of pathology at Stanford University and pathologist-in-chief to the Stanford University Hospitals in San Francisco, has become professor of pathology at the college.

DR. CHARLES WILLIAM HUNTLEY, of Mather College, Western Reserve University, has been appointed assistant professor of psychology in both Adelbert and Mather Colleges. He will be in addition dean of Adelbert College, succeeding Dr. Robert E. Bates, who has resigned to become assistant professor of geology and assistant dean at Indiana University.

DR. ALEXANDER LOWY, professor of organic chemistry in the University of Pittsburgh, and Dr. LeRoy S. Weatherby, professor of organic chemistry in the University of Southern California, will exchange positions during the summer of 1941.

PROFESSOR JOSEPH W. BARKER, dean of the School of Engineering of Columbia University, has been appointed special assistant to Assistant Secretary of the Navy Lewis Compton to serve as chief of the Division of Training Liaison and Coordination. Professor Barker will be the representative of the Navy Department in cooperating with other government agencies. He also will confer with all bureaus and offices within the department on matters of civilian vocational and non-military training. James Kip Finch, Renwick professor of civil engineering, will be acting dean during Dean Barker's absence.

DR. ALEX J. STEIGMAN, formerly of the department of pediatrics of the University of Pennsylvania Medical School and the Children's Hospital of Philadelphia, now of the Harvard University Medical School, has left for England to take up his post as pediatrician to the American Red Cross-Harvard University Hospital for Infectious Diseases.

DR. WILLIAM BEEBE has returned from a two weeks' visit to Bermuda. The United States Government has decided that the house and grounds of New Nonsuch are not required for part of the American Army Base, so the laboratory of the New York Zoological Society, which has been used for deep sea work by Dr. Beebe and his staff for the past thirteen years, will be safe for future research. This field station of the Zoological Society will, however, not be used for scientific work throughout the duration of the war. The present extensive, deep dredging of the Army Base in Castle Harbor is bringing up a great number of rare and interesting mollusks, worms and corals, as well as many crayfish, octopus and fish of various species.

DR. ARTHUR G. KEVORKIAN, assistant plant pathologist and physiologist of the Puerto Rico Experiment Station of the U. S. Department of Agriculture, who has been engaged in vanilla and cinchona culture, has been loaned to the Ecuadorian Government for work on agricultural problems.

DR. WAYNE B. HALES, professor of physics and mathematics at Brigham Young University, is serving as instructor in charge of meteorology at the Randolph Flying Field, San Antonio, Texas. He will occupy this position until the autumn, or longer, depending on national need. For a year previous to his leaving this spring for Texas, he taught meteorology and navigation to holders of Civil Aeronautics Authority scholarships at the university.

THE seventeenth annual meeting of the New York State Geological Association was held in Rochester, N. Y., on May 9 and 10. The University of Rochester acted as host. The total attendance was 132, and nineteen institutions were represented. The afternoon of the first day was devoted to a field trip in the vicinity of Rochester. The glacial geology and the famous Silurian stratigraphy of the region was reviewed. On May 10 a field trip was taken to the area south of Rochester along the Genesee River Valley. Here the glacial geology and Devonian stratigraphy was studied. The trip ended at Letchworth Park, near Portageville. Dr. Thomas M. Hills, professor of geology at Vassar College, was elected president of the association, and Dr. Aldred S. Warthin, Jr., associate professor of geology, was elected secretary. The next annual meeting will take place at Poughkeepsie, N. Y., in the spring of 1942.

SEYMOUR W. FERRIS, chief chemist of the Atlantic Refining Company, has been appointed chairman of a general committee to direct arrangements for the one hundred and second meeting of the American Chemical Society, which, under the auspices of the Philadelphia Section, will be held at Atlantic City, N. J., from September 8 to 12. More than 5,000 chemists, chemical engineers, industrialists, educators and representatives of allied fields, including state and federal services, will participate in the events. The effort of the chemical industry to speed defense will be stressed at the convention in which eighteen divisions of the society will participate and which is expected to be one of the largest in the history of the society. There will be seventy-eight sessions, at which research in practically every aspect of pure and applied chemistry will be reported. Seventeen special symposia will deal with subjects such as fuels, food, petroleum, phosphates, rubber, medicinals, unit processes in industry and biological problems related to national defense.

THE Government is looking for mineralogists especially qualified in the economic aspects of the mineral industries to carry on professional research in the fields of minerals, coal and petroleum as mineral resources which are of the utmost importance to National Defense. Civil-service examinations for these positions are now open. The salaries range from $2,600 to $5,600 a year. Applications will be rated as received at the Commission's Washington Office, but those interested are urged to file their applications at once. Applicants will not have to take a written test, but they are required to submit a list of whatever writings they have done in the field, and, if possible, to submit a copy of at least one research project. Particulars and application forms may be obtained from any first- or second-class post office or from the Civil Service Commission, Washington, D. C.

THE University of Miami, Coral Gables, Fla, plans to offer this year two courses in marine zoology, lasting from June 23 to July 19, running concurrently. One course, designed for students with elementary training only, will be principally concerned with the invertebrate fauna of the tropical region, from the viewpoints of anatomy, physiology, habits and ecology. Advanced students will survey the problems and methods of marine research, and will be encouraged to follow up a problem in conjunction with the work of the courses.

DISCUSSION

A GROWTH-DEPRESSANT SUBSTANCE FROM YEAST

AT various times Fernbach,[1] Hayduck[2] and Gilles[3] have presented evidence that yeast contains substances toxic for yeast and for some bacteria and molds. In a previous communication[4] dealing with fractions from yeast which antagonize the toxic action of germicides for *Aspergillus niger* and *Penicillium glabrum* we pointed out that growth-inhibitory substances were also indicated to be present. Preliminary experiments show that these materials can be concentrated.

One liter of a concentrated alcoholic extract of 20 pounds of bakers' yeast, prepared as described previously,[5] was fractionally precipitated with three portions of acetone (10 l., 3 l. and 3 l., respectively), concentrating the solution between each acetone addition. The final acetone-soluble portion (Fraction 5 F) was approximately fifty times as active as the original extract in depressing the growth of both *A. niger* and *P. glabrum* when added to the culture medium in concentrations of from 0.05 to 1.0 per cent. This fraction was dried at 50° C. to a dark oil, extracted twice overnight with acetone, and adsorbed on Norit charcoal from which it was eluted with 85 per cent. acetone. This fraction (5 H) possessed over twice the inhibitory activity of 5 F for *A. niger* but was no more potent for *P. glabrum*. The materials have also been prepared by direct acetone extraction of the yeast, followed by the above treatments.

Fractions corresponding to 5 F have also been tested for their effect on the growth of *Escherichia coli* and *Staphylococcus aureus*. Complete killing of none of the organisms has been obtained, but the rate of growth is greatly depressed by addition of about 2 per cent. or greater of the fractions; lower concentrations cause an increase in colony size.

Of considerable interest is the fact that in the case of both molds and bacteria the type of growth is altered. For the molds grown on a modified Czapek's medium containing the depressant this change consists of the production of thick gnarled mycelia, and the lack of conidia and pigment formation. The form of colony of *E. coli* on nutrient agar containing the depressant is changed from smooth to rough to grainy with increasing concentrations. Microscopically this change is associated with a great increase in the length of the *E. coli* cell and the development of tangled filamentous structures. Reversion to normal, highly motile forms occurs when the cultures are returned to media free of the depressant. The relationship be-

[1] A. Fernbach, *Compt. rend.*, 149: 437, 1909; *Ann. brass. distill.*, 12: 361.
[2] F. Hayduck, *Wochschr. Brau.*, 26: 177, 189, 677.
[3] E. Gilles, *Bull. mens. soc. Linnéenne Lyon*, 8: 126, 1939.
[4] E. S. Cook and C. W. Kreke, *Nature*, 146: 668, 1940.
[5] E. S. Cook, C. W. Kreke and L. G. Nutini, *Studies Inst. Divi Thomae*, 2: 23, 1938.

tween the morphological and biochemical changes and the possible effect on virulence are being studied.

The concentrates at present available are manifestly crude, but the active material (or materials) is non-volatile, readily soluble in water, 95 per cent. alcohol and acetone containing a trace of water, and is stable at 100° C. at pH 7.3. The concentrates are acid and contain nitrogen but no sulfur. They give a positive biuret reaction, but it appears likely that the protein is present as an impurity.

These experiments are being extended and will be reported in detail later.

ELTON S. COOK
CORNELIUS W. KREKE
SISTER M. CRESCENTIA GIERSCH, S.S.J.
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INSTITUTUM DIVI THOMAE

DIETARY REPAIR OF EXPERIMENTAL CARIES[1]

EXPERIMENTAL caries was produced by feeding rats a coarse-corn, caries-producing diet[2] for 100 days. Animals sacrificed at the end of this period showed evidence of carious disintegration in the molar teeth. By examination under binocular microscope, using a fine explorer to test the cavity formation, soft areas of exposed dentin could be noticed. Upon histological examination the lesions showed deep penetration with the cavity base in close proximity to the pulp chamber and with little evidence of secondary dentin formation. One group of rats which had been on the caries-producing diet during the same period (100 days) were continued for an additional 2 months, during which time they received the stock diet of this laboratory (finely ground fox chow) that has been shown to be adequate in every respect. After the two months on this diet, the rats were sacrificed and the molar teeth examined.

Unexpectedly, the caries process had not only stopped but under binocular examination the exposed dentin was found hard and polished. Histological study of these teeth showed an unusual picture. The dentin had a sclerotic appearance and beneath every place where the outer part of the tooth had been subject to attack a new thick layer of secondary dentin had been laid down, which reestablished a safe distance between the external tooth surface and the pulp. In some cases this protective layer had attained the thickness of the original dentin.

This experimental approach, which permits histological evaluation of the reparative processes associated with carious disintegration, should offer a new field of investigation of the dietary and other factors involved in the control of dental caries. If such defensive processes can be promoted and the acute caries penetration prevented, it should be possible to save many teeth from severe destruction and its consequences.

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[1] This work was carried out with a grant from the Carnegie Corporation of New York.

[2] C. A. Hoppert, P. A. Webber and T. L. Canniff, SCIENCE, 74: 77, July 17, 1931.

RATE OF SURFACE RETREAT OF SEA CLIFFS BASED ON DATED INSCRIPTIONS[1]

SINCE the time of cave man, people have responded more or less to an urge to draw pictures or cut inscriptions on walls. Although this habit is often objectionable, some use can be made of it geologically in estimating the rate of rock surface weathering and erosion.

Near La Jolla, California, the sea cliffs are largely composed of Cretaceous and Eocene rock. Much of this material is sandstone, consisting of medium to coarse-grained quartz and feldspar, moderately to firmly cemented by $CaCO_3$ when fresh, but friable when weathered. Along four miles of this coast a great number of roughly carved names or initials were found on the sandstone during August, 1940. Even though fewer than 10 per cent. were accompanied by the date on which the carving was made, a total of 163 dated inscriptions were located. Since beach vacationists have come to La Jolla for many years, an interesting frequency curve for such dated signatures can be made (Fig. 1). Enough data are available so that the effect of a few deeply cut carvings, of falsification and of errors in reading partly obliterated dates is minimized.

Most of the freshly cut letters are a sixteenth to a quarter of an inch deep. Within a few months after being cut, definite signs of solution and wearing away of the edges appear, until in about a year there remain no sharp edges whatever. In two or three years the lines usually become only broad shallow grooves in the rock surface and in four or five years they are partly obliterated and can be read only with difficulty. In several instances, where the grooves for old carvings had been almost completely destroyed, the lines are partly shown by rows of barnacles which had lived in the grooves probably because a water film was held there longer than on the flat rock surface.

Destruction of the carvings seems to take place largely through solution of the $CaCO_3$ cement in the rock. The loosened grains may be detached by the formation of salt crystals developed by the evaporation of spray or at some localities they may be carried away

[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 138.

through direct erosion by sediment-laden waves. Interestingly enough, the dates which have remained legible for the longest time are those cut on the walls of caves or narrow inlets where the rock rarely becomes completely dry.

On the basis of carvings made in 1940, the depth of the average inscription was estimated to be one eighth inch. If six years are required to obliterate a carving (Fig. 1), a period of about 600 years would be necessary for surface weathering and erosion alone to cause the sandstone cliffs to retreat one foot. This figure probably represents a maximum rate for the sandstone, however, since obliteration takes place not only by retreat of the entire cliff front, but also by mere broadening of the letters into a wide hollow. A much higher rate of retreat exists for local cliffs of relatively unconsolidated terrace material near La Jolla. These are cut back by waves and rain wash so rapidly that only one or two 1940 carvings were found. An even lower rate for limestone (one foot in 6,000 years) was obtained by Goodchild[2] through the investigation of gravestones. The slowness of the retreat suggests that other processes such as undercutting by waves is primarily responsible for the cutting back of the cliffs at La Jolla. At the rate of retreat of one foot in 600 years, a cliff twenty feet high would contribute to the beach about 3.3 cubic feet of sand annually for each one hundred feet of its length. Although the method is subject to errors, it may be an approach for determining relative rates of surface weathering and erosion in other areas.

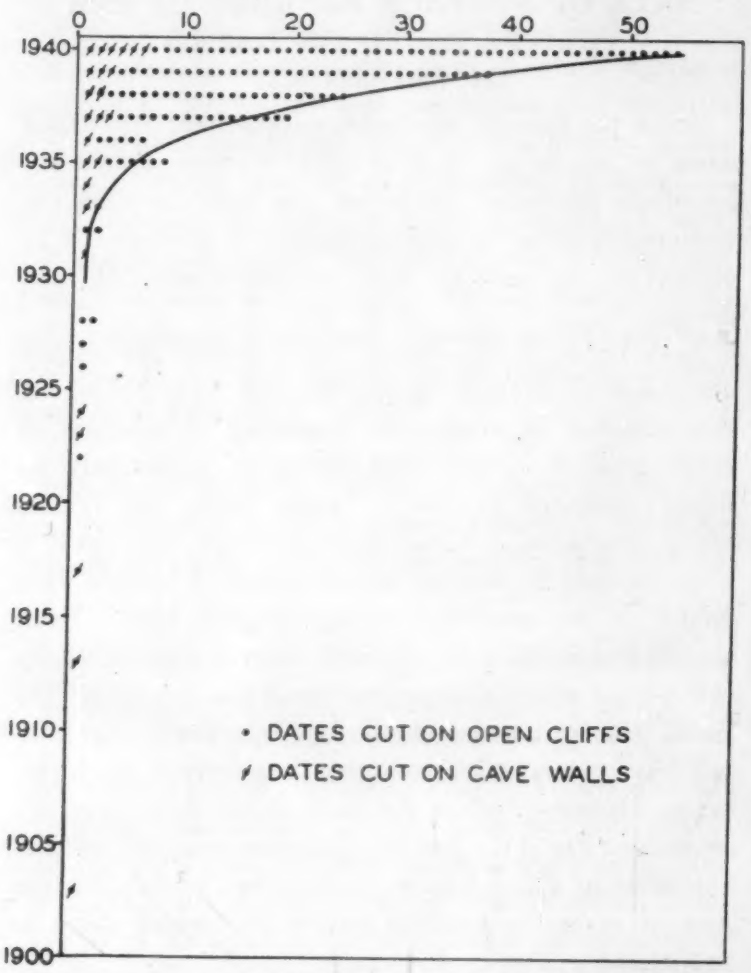

FIG. 1. Graph showing number of dated inscriptions found cut in sandstone sea cliffs near La Jolla, California.

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MAN'S BIOLOGICAL DESTINY

PROFESSOR ELIOT BLACKWELDER, speaking as retiring president of the Geological Society of America in an address published in SCIENCE for April 18, 1941, under the title "Science and Human Prospects," takes the view that man as a species is limited in power to improve native ability, except to such degree as may be accomplished by educational methods. However, no reason exists for so pessimistic a view because the human species is subject to biological laws that differ in no essential respect from the laws that govern animal and plant life. Surely, then, what has been accomplished with animals and plants can be repeated with man. Some of the work on animal and plant improvement was reviewed in the *American Naturalist*[1] not very long ago, and while this point was not discussed in that review, the work reviewed demonstrates that man holds his biological destiny in his own hands. And since the publication of the *American Naturalist* article, further gains have been made in the work at Mount Hope.

Purely voluntary action by a comparatively small number of people can develop a race of human beings whose brains would have most of the qualities which Professor Blackwelder wonders if man's successor on this planet may not possess, just as certainly as the abilities of animals have been improved. And the task will require such a small number of generations that it will doubtless seem like an instantaneous change to geologists. Nevertheless, a race of human beings whose poorest brains are superior to the best of to-day might have the same difficulties with human relationships as exist to-day because so many human relationships are governed by social inheritance rather than biological inheritance. As Professor Blackwelder puts it, ". . . and above all will his life and conduct be controlled by his intellect rather than by his feelings?"

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FURTHER COMMENT ON PRESERVATION OF NATURAL AREAS

THE comment of Dr. Willard G. Van Name in SCIENCE for May 2, 1941, emphasizes further the need

[1] H. D. Goodale, *American Naturalist*, 72: 740, 243, May–June, 1938.

[2] J. G. Goodchild, *Geol. Mag.*, 12: 326, 1875; *Geol. Mag.*, 27: 463–466, 1890.

for planning in the preservation of natural plant and animal habitats. I can not share his rather sweeping criticism of the U. S. Forest Service, however. This agency has been committed to a policy of multiple use management for over thirty years—the greatest good to the greatest number in the long run. Its administrators have faithfully tried to follow this policy. It is only natural, then, that the large "roadless areas" and "primitive areas," often containing over a million acres in one block, should be scrutinized for other possible public uses before being set aside. The late Dr. Robert Marshall, the chief advocate of such a classification, was keenly alive to the needs of society as a whole, as well as being a trained plant physiologist. Naturally such large tracts could not be closed to productive use where local industries and communities would thereby suffer hardship. The U. S. Forest Service tries to stabilize communities by insuring a continuous supply of raw material.

Really valuable commercial timberland has, however, been reserved from all cutting and made permanent natural areas by the U. S. Forest Service in a large number of cases, such as the Port Orford cedar reserve and the Tionesta virgin forest in Pennsylvania, to which I took pains to refer in my note in SCIENCE of January 24, which Dr. Van Name does me the favor to quote. This latter area has been carefully zoned to insure adequate undisturbed environments for scientific study. One of the virgin forest areas on the White Mt. National Forest known as the "Bowl," containing 500 acres of magnificent virgin spruce, had so much commercial value that salvage operations were possible after it was destroyed by the hurricane; this many privately owned commercial forests did not have!

While both the U. S. Forest Service and the National Park Service have reserved a very imposing number of natural areas, I fully agree with Dr. Van Name that there are still others equally deserving of attention. In this connection one may even raise the question whether public ownership of this sort is always necessary or best. Some reserves owned by private universities or schools or scientific societies may be even safer from disturbance.

Finally I wish to correct any impression that may have been gained that I would recommend "that the first thing to do is to spend a number of years in an 'inventory' of desirable areas"—while immediate action is needed to save threatened fauna or flora. Certainly not. While unfortunately some surveys of this kind tend to drag on, there is no real reason why an inventory should not be completed in a few months at most if the cooperation of all naturalists were to be enlisted and the country divided into districts. Dr. S. Charles Kendeigh (Vivarium Building, Champaign, Ill.), chairman of the Ecological Society of America Committee for the Study of Plant and Animal Communities, has amassed a large volume already in the course of a survey of areas now reserved or in need of protection. This study could provide a basis for a comprehensive plan for the country to which federal agencies and state planning boards could make substantial and necessary contributions.

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SCIENTIFIC BOOKS

ORIENTATION

The Orientation of Animals, Kineses, Taxes and Compass Reactions. By GOTTFRIED FRAENKEL and DONALD L. GUNN. 352 pp. Oxford University Press. 1940.

THE first part of this volume is intended primarily as a text for undergraduates; the second (pages 136–352) primarily as a handbook for investigators. The aim of the authors is to classify responses already known rather than to elucidate the mechanism involved in the responses.

The classification proposed is a modification of that formulated by Kühn in 1919. The responses are divided into three main categories, designated kineses, taxes and transverse orientations and these are subdivided respectively into ortho- and klino-kinesis; klino- tropo- and telo-taxis; light compass reactions, dorsal and ventral light reactions and ventral earth reactions. Known responses are selected to illustrate the characteristics of each division in the classification, but there is no attempt to classify all the responses which have been described.

Nearly all the categories in the classification appeared long ago under different names, *e.g.,* kineses as changes in rate of response or undirected responses, taxes as directed responses or tropisms, klino-taxis as indirect orientation or orientation by "trial and error," "random movements" or "shock-reactions," tropo- and telo-taxis as direct orientation.

The authors maintain (p. 65) that in the new classification all anthropomorphic implications are eliminated, that the terms used are precisely defined and that it is consequently superior to former classifications which contain such anthropomorphic phrases as "trial and error" (Jennings), and "selection of random movements" (Holmes); and such ill-defined phrases as

"shock-reactions" (Mast). They even contend (p. 9) that if this classification had been formulated earlier, the controversies concerning Loeb's theories would have been to a large extent avoided.

But in spite of their contentions it must be said that they did not well succeed either in avoiding anthropomorphic implications or in precision in defining terms. They say, *e.g.* (pp. 64 and 77), "klino-taxis involves comparison of intensities at successive points in time" and "tropo-taxis simultaneous comparison of intensities on the two sides." How, it may be asked, is an animal to compare intensities at successive points in time without reason and memory? Aren't these phrases fully as heavily loaded with anthropomorphic implications as those which the authors reject?

The authors (p. 134) define "klino-taxis" as "attainment of orientation indirect, by interruption of regularly alternating lateral deviations of part or whole of body, by comparison of intensities of stimulation which are successive in time; examples, fly larvae, *Euglena,* larvae of *Arenicola, Amaroncium.*" It so happens, however, that in none of these animals are the processes involved in orientation in accord with the definition of "klino-taxis" given. Orientation in photo-positive specimens is brought about by a series of responses to shadows cast on the photo-sensitive tissue by opaque structures in the body and rotation on the longitudinal axis, *i.e.,* by a series of shock-reactions. These continue until the organism faces the light, after which rotation no longer produces shadows on the photo-sensitive tissue. There is no indication whatever of "comparison of intensities of stimulation." They say: "photo-taxis means respectively movement straight toward or straight away from the light." Animals, however, rarely, if ever, take a straight course. They say (p. 93): "When the frontal ommatidia alone are stimulated, the bee walks straight forward." But they present no evidence indicating that these ommatidia are actually stimulated. Then, too, light, gravity, etc., are frequently referred to as stimuli in place of stimulating agents.

It is indeed questionable whether the new nomenclature is superior to the old, either in avoidance of anthropomorphic implications or in precision in meaning. Moreover, terms like taxis and tropisms often tend to inhibit investigation; for they encourage placing phenomena in categories as an ultimate aim rather than knowledge concerning the processes involved in the phenomena. Then, too, they readily acquire the status of causal agents. Has not every scientist experienced this? Indeed, it is not difficult to ascribe causality to taxis in the following quotation (p. 298): "Negative photo-taxis takes it [*Litorina*] inward on the floor, negative geo-taxis upwards on the end of the wall, and positive photo-taxis outwards."

The authors are a bit careless in reference to credit for priority; and the accuracy of a considerable number of statements is questionable. For example, the first analysis of photic orientation should be credited to Ray, 1693; in place of De Candolle, 1832 (p. 5); the idea that the enlargement in the flagellum in *Euglena* is photo-sensitive should be credited to Mast, 1911, in place of Tschakhotine, 1936 (p. 70); the fact that blow-fly larvae "give the same response to changes of intensity when the light is all from above . . . and when it is presented as a horizontal beam" should be credited to Mast, 1911, in place of Gunn, unpublished (p. 67); the nature of the response of Hydra in a horizontal beam of light should be credited to Mast, 1911, in place of Haug, 1933 (p. 74); the fact that insects after one eye is covered gradually go more directly toward the light should be credited to Radl, 1903, in place of Minnich, 1919 (p. 93). The authors say that Loeb "uses the term (tropism) in two senses," whereas he uses it in at least four (p. 9). They say Mast calls orientation in fly larvae a shock-reaction, whereas he maintains that the larvae orient by means of a series of shock-reactions (p. 64). They contend (referring to orientation of *Euglena*) that it is not known how "a turn away from the light is responsible for causing the path to curve toward the light," whereas Mast, 1911, has described this in detail (p. 72). They say the larva of *Arenicola* has but one eye, whereas it is well known that it has two (p. 73).

Classification of responses is obviously a difficult and an important problem. The more thought devoted to it, the better. The volume under consideration is at least a worthwhile attempt to contribute to its solution. It will doubtless arouse interest in the study of the nature and the significance of responses as well as in their classification.

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RAMANUJAN

Ramanujan. Twelve lectures on subjects suggested by his life and work. By G. H. HARDY. 236 pp. Cambridge: at the University Press, 1940. New York: The Macmillan Company, 1941. $6.00.

IN 1936, as part of the Harvard Tercentary celebration, the author delivered two lectures on the subject: The Indian Mathematician Ramanujan and his work. The first lecture, much the more biographical of the two, was published in volume 44 of the *American Mathematical Monthly,* and is reprinted in the present book as Lecture I. The original second lecture, which dealt more with Ramanujan's contributions to mathematics, has now been expanded to make the other eleven lectures. Most of this expansion, naturally enough, is the result of having adequate space to tell

more than the bare facts about Ramanujan's work. Some of it, however, is due to the fact that since 1936 much new work has been done on certain of his problems. Lectures VIII and X on the asymptotic theory of partitions and on Ramanujan's function $\tau(n)$ contain a great deal of recent mathematics. The connections between Ramanujan's work and that of other writers, especially those who came after him, are traced in each lecture with many interesting comments. Each lecture closes with a set of valuable notes, and there is a bibliography of over 100 papers on problems suggested by Ramanujan.

Ramanujan surpassed all other men in his ability to produce striking formulas. Opening the book at almost any place one is sure to find some arresting equality, something typographically complicated with bizarre exponents and coefficients. In this respect Ramanujan differed from the typical modern mathematician who is trying to find the simplest possible relationships between extremely general concepts. The actual source of one of these startling formulas is often mysterious, and the author frequently indulges in interesting speculations. It is true that Ramanujan discovered a number of interesting results experimentally, but his experiments were never on a large scale. Many of the formulas which he gave as approximately correct are not as accurate as he had surmised, as a little experimenting would have shown. Perhaps his most interesting use of the experimental method occurs in connection with the study of his function $\tau(n)$, defined as the coefficient of x^{n-1} in the expansion of the 24th power of $(1-x)(1-x^2)(1-x^3)\ldots$. After examining the first 5,000 of these coefficients $\tau(n)$ and finding only one divisible by 691 he had the courage to conjecture that $\tau(n)$ is divisible by 691 for *almost all* n, a conjecture which later proved to be true.

The reader who is unable to appreciate Ramanujan's fields of endeavor, but who is interested in what constitutes and causes mathematical genius will find the book absorbing. There are several interesting passages on the subject of "proof" and what it meant to Ramanujan. The book is written in the best Hardy style.

D. H. LEHMER

UNIVERSITY OF CALIFORNIA

SOCIETIES AND MEETINGS

THE ILLINOIS STATE ACADEMY OF SCIENCE

THE thirty-fourth annual meeting of the Illinois State Academy of Science was held at Northwestern University, Evanston, Illinois, on May 1, 2 and 3. Cooperating as hosts to the State Academy were the museums and other interested organizations in the Chicago area. Over 500 registered for the meeting and 150 lectures, scientific papers and reports were given.

Some of the high-lights of the meeting were the addresses at the general session on Friday morning, the lecture given to both the Senior and Junior Academy members on Friday evening, and the tours of the museums on Saturday morning. Dr. V. O. Graham, the retiring president, gave an illustrated lecture Friday morning on "Fungi and Man." This was followed by a description and records showing "Patterns in Negro Music" by Dr. M. J. Herskovits. "Wood Duck Studies in Illinois" by Dr. T. H. Frison completed the Friday morning program.

The afternoon was devoted to section meetings. There were twelve of these, Botany, Physics and Zoology holding double sessions. The symposium on "Animal Geography in Illinois" and one on "Endocrinology" planned by Dr. W. V. Balduf, chairman of the Zoology section, were particularly well received. The Association of Physics Teachers of Illinois, an affiliated society, sponsored the Physics program, and Dr. P. A. Constantinides, the chairman, arranged two interesting sessions, the main theme being applied physics. Almost all the sections were well attended and the academy is pleased to announce the formation of a new section for Illinois in Social Science. All those interested in this group are urged to get in touch with the chairman for 1941–42, Dr. John Kinneman, of Normal, Illinois.

At the banquet in the evening the American Association for the Advancement of Science awards were announced, grants in aid being made to C. L. Furrow, of Knox College, Galesburg, Illinois; C. C. Hoff, of the University of Illinois, Urbana, Illinois; J. F. Stanfield, of Chicago Teachers College, Chicago, Illinois; and P. H. Kinsel, of Edwardsville High School, Edwardsville, Illinois. While these grants can not be large, they have always served to stimulate research interest.

The evening program consisted of an illustrated address and colored moving pictures given by Dr. Ralph Buchsbaum on "A Summer in a Tropical Rain Forest of Barro Colorado Island, Panama." A group of nearly a thousand Junior and Senior Academy members attended this lecture. After the lecture the awards given by the Junior and Senior Academy to winners in the Junior Academy exhibits were presented. Altogether over 300 certificates were awarded, as well as cups for unusually worth-while work in the various sciences. The American Association for the Advancement of Science Junior Academy awards went

to Mary Cathrine Rowley, Canton, Illinois, and Bill Hahn, Rockford, Illinois. These awards were especially well received and help to maintain interest in the Junior Academy group. No one could have attended this meeting without realizing that the oncoming generation of scientists will be an active and able one.

On Saturday morning so many private cars were available that only two bus loads of academy members went on the museum trips. So many possibilities were offered that the number in attendance at any one meeting was small, but many reports of interesting and worth-while experiences were heard.

At the council meeting it was voted to accept the invitation of the University of Illinois to hold the annual meeting of 1942 in Urbana. This is in line with the policy of the academy to hold its meetings in various parts of the state. The section chairmen in charge of the several groups in the academy are:

Agriculture—C. H. Oathout, Macomb, Illinois.
Anthropology—D. E. Wray, Peoria, Illinois.
Botany—J. F. Stanfield, Chicago Teachers College, Chicago, Ill.
Chemistry—N. D. Cheronis, 5556 Ardmore Avenue, Chicago, Illinois.
Geography—J. E. Van Riper, Carbondale, Illinois.
Geology—A. H. Sutton, Urbana, Illinois.
Physics—F. L. Verwiebe, Charleston, Illinois.
Psychology and Education—J. M. Hughes, Northwestern University, Evanston, Illinois.
Social Science—John Kinneman, Normal, Illinois.
Zoology—O. Parks, Northwestern University, Evanston, Illinois.

The section chairman of the academy has always been the nucleus about which the Illinois Academy functions. A great deal of appreciation has been voiced for the work of the retiring chairmen and the officials at Northwestern who cooperated so effectively. Plans for the 1942 meeting at the University of Illinois are already being formed. Local officers to whom inquiries concerning the activities of the academy and in particular, questions on plans for the 1942 meeting, may be addressed are: *President,* Dr. T. H. Frison, Natural Resources Building, Urbana, Illinois; *General Chairman,* Dr. G. E. Ekblaw, Natural Resources Building, Urbana, Illinois; *Secretary,* Dr. R. F. Paton, Department of Physics, University of Illinois, Urbana, Illinois.

The chairman of the Junior Academy, Mrs. Mary Creager, Vienna, Illinois, has immediate charge of the Junior Science activities. It seesm likely now that facilities will be available at the University of Urbana to hold a more effective exhibit of science work in the secondary schools than is usually the case. Buildings will probably be available to permit setting up these exhibits for several days. Many high schools are already cooperating in this program and the activities of the science clubs in the high schools of the state are being recognized as an important tool of the educator.

Illinois wishes to announce also that active plans are underway to promote scientific meetings among interested student groups of college level. This movement is attracting much favorable attention among several of the state academies.

R. F. PATON,
Secretary

SPECIAL ARTICLES

THE EFFECT OF 2, 3, 5, TRIIODOBENZOATE ON THE GROWTH OF TUBERCLE BACILLI

IT has been shown that the addition of salicylate to a washed suspension of tubercle bacilli of the B_1 and H37 strains increases their oxygen uptake.[1] Certain other substances have similar effects and an attempt was made to find a compound which would inhibit the extra oxygen uptake. 2, 3, 5, triiodobenzoate was found to cause a marked inhibition (Fig. 1). The effect on growth of this and similar compounds was then tried.

Both the B_1 and H37 strains were used and gave similar results. The culture medium was a veal glycerine infusion broth adjusted to pH 6.7. The cultures were incubated at 37° C. The area of growth was measured daily and the average of five bottles was used for each point. When the areas showed definite differences the bottles were autoclaved and the bacteria filtered, dried and weighed. The differences found by area and weight usually checked within 10 per cent. The triiodobenzoate obtained from Eastman Kodak Company was recrystallized from glacial acetic acid and neutralized to pH 6.7. Fig. 2 shows that in very small concentrations it inhibits growth. If a culture which has not grown in the presence of triiodobenzoate is transferred to fresh medium, growth will occur showing that the cells have not been killed. If the drug is added during the rapid growth phase inhibition also occurs.

The importance of substitution in the ortho position of the benzoic acid is shown by the fact that 3, 5, diiodo-2-hydroxybenzoate is as effective as triiodobenzoate in inhibiting growth, whereas 3, 5, diiodo-4-hydroxybenzoate requires a much higher concentration. Salicylate itself, although it increases oxygen uptake,

[1] F. Bernheim, SCIENCE, 92: 204, 1940; *Jour. Bact.* (in press).

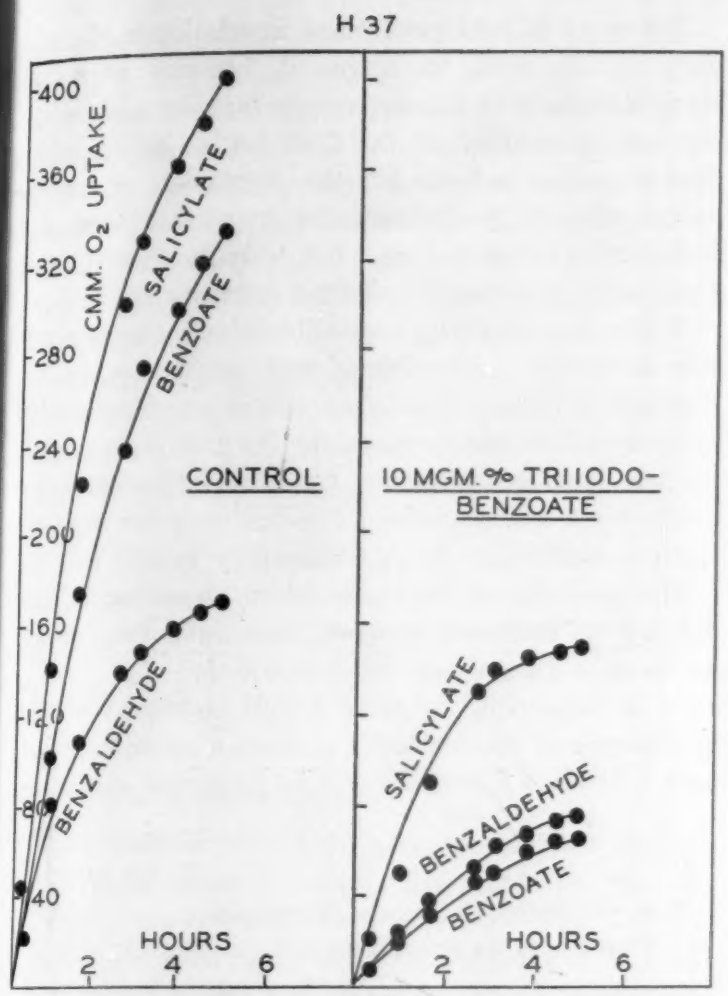

FIG. 1. The effect of 1.0 mg each of salicylate, benzoate and benzaldehyde on the oxygen uptake of a washed suspension of tubercle bacilli, H37 strain, in the presence and absence of 2, 3, 5, triiodobenzoate. pH 6.7. 37° C. The control uptake of the tubercle bacilli has been subtracted.

inhibits growth. The effect of many other similar compounds will be reported elsewhere.

Triiodobenzoate is tolerated by rats when given intraperitoneally in daily doses of 100 mg/kg. Daily doses of 100 mg/kg by mouth are tolerated by guinea pigs. 1.0 gm a day can be taken orally by man without apparent ill effects. It is absorbed from the gastrointestinal tract.

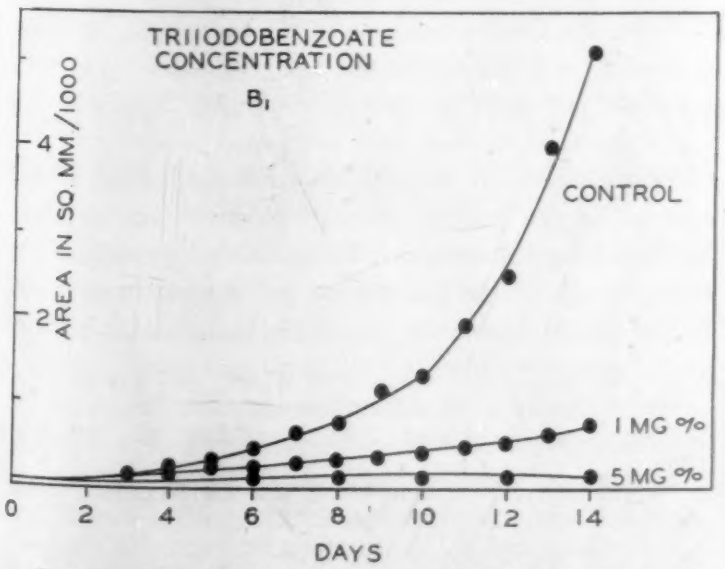

FIG. 2. The effect of 2, 3, 5, triiodobenzoate on the growth of the B_1 strain of tubercle bacilli.

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THE MINIMUM BASE VALUE OF HEAT PRODUCTION IN ANIMALS

THE writers and their associates have advocated in several papers[1-8] the idea that there is an energy expense of utilization of the body tissue nutrients as katabolized, which implies that the base value of heat production is less than that of fast.

This conception, which may be considered to follow from the observation by Rubner,[9] and by others later, that there is an increase in heat production accompanying the increase in protein katabolism during fast, involves important consequences which the authors would emphasize in relation to the determination of the heat increments (dynamic effects) of nutrients and of diets.

With the understanding that metabolizable food nutrients and metabolizable nutrients of body origin are in essentially the same fundamental status as sources of nutrient energy, and that the nutrients from both sources, as katabolized at planes of nutrition below that of energy equilibrium, represent in part net energy and in part energy expense of utilization, the authors and their associates take the position that heat increments based on the heat production of fast, or determined under conditions implying the heat production of fast as the base value, are in error by the amount of the dynamic effect of the body nutrients spared.

In recent calorimetric experiments at this institute, the results of which are not yet published in detail, an attempt was made to estimate the base value of heat production in cattle.

In these experiments the energy expense of utilization of the body nutrients katabolized during fast was estimated as the increase in heat production following the feeding of oleo oil and dried beef muscle (to represent the body nutrients katabolized during fast) to steers established in approximate energy equilibrium; and the net energy of the body nutrients katabolized (the heat production of fast minus the energy expense of utilization of the fasting nutrients) was considered to represent the theoretical minimum base value of heat production.

1 *Jour. Agr. Research*, 34: 166, 1927.
2 *Ibid.*, 37: 253, 1928.
3 *Ibid.*, 40: 37, 1930.
4 *Ibid.*, 43: 1003, 1931.
5 *Jour. Nutr.*, 5: 183, 1932.
6 *Ibid.*, 15: 505, 1938.
7 *Ibid.*, 21: 257, 1941.
8 *Ibid.*, 8: 509, 1934.
9 "Die Gesetze des Energieverbrauchs bei der Ernährung," 1902.

In the calorimetric experiments referred to the energy expense of utilization of body nutrients katabolized was tentatively found, as an average of five determinations, to be equivalent to 14.4 cal. per kilogram of live weight during fast and equal time standing and lying, or to 12.6 calories per kilogram during fast in the lying position alone, or to 26.5 per cent. of the metabolizable energy of the oleo oil and dried beef muscle fed to represent the body nutrients katabolized.

To demonstrate the significance of the theoretical base value of energy metabolism, a graph is presented (Fig. 1) representing previously determined curves of

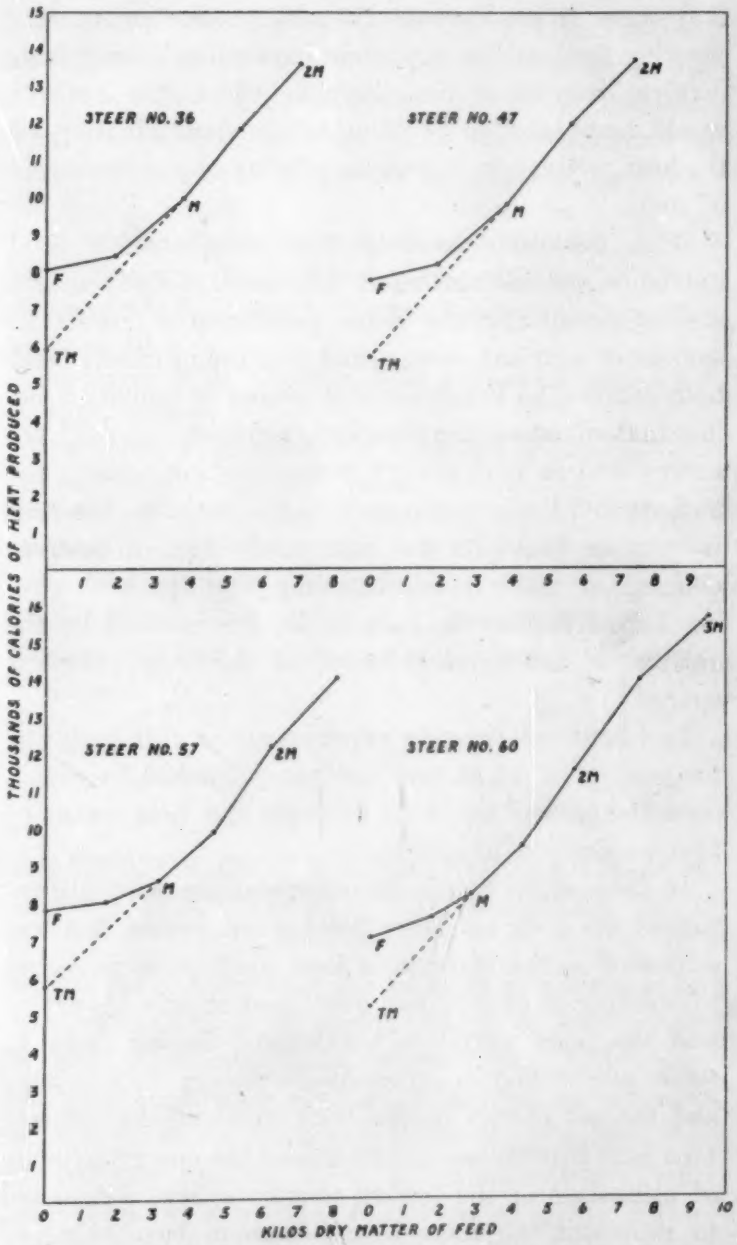

FIG. 1. Relation of heat production to food consumption, as observed and as corrected for dynamic effect of body nutrients katabolized. M = maintenance, F = fast, and TM = theoretical minimum heat production.

heat production in relation to food consumed with four steers, (1) as observed, and (2) as corrected by the use of the recently determined factor for computing the dynamic effect of body nutrients katabolized.

The curve of heat production in relation to the energy of the food, so corrected, becomes nearly a straight line up to the moderately high level at which the metabolizability of the food begins to diminish, thus providing a basis for the expression of energy values of diets, and energy requirements of animals, both for maintenance and for body increase in the same terms, presumably without extensive error.

While it is obviously impossible directly to measure this theoretical base value of heat production, as defined, the indirect estimation which is presented serves at least to illustrate the point of view that there is such a value, and that dynamic effects of nutrients as directly observed at planes of nutrition below that of energy equilibrium are fundamentally invalid.

The maintenance heat production, therefore, is considered the most nearly correct base value from which to measure dynamic effects in nutrition.

It is impossible to make a full statement of the philosophy of this matter in so short a communication, and a detailed discussion will be presented elsewhere.

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ESTIMATION, ISOLATION AND IDENTIFICATION OF AUXINS IN PLANT MATERIAL

FOR estimation and concentration of auxins the following methods have been used, namely, the diffusion method,[1] the extraction process,[2] the enzymatic method (lipase,[3] chymotrypsin[3a]), the alkaline alcoholic hydrolysis[4] and the biological digestion method.[3]

The biological digestion method of Kögl, Haagen-Smit and Erxleben as performed by feeding experiments on humans is capable of giving the total hormone content, both the free hormone and the precursor form (or bound form) as well. By necessity this method is limited in its application.

Using the results obtained in the biological digestion method as a criterion for the assay of the total growth hormone set free in dormant tissues, the following more practical method was developed, whereby one is able to remove an amount which is equivalent to the amount of the growth promoting substances obtained by the biological method. This modified procedure has been in use in this laboratory for the past two years in the investigation of auxin-like substances in high

[1] F. W. Went, *Rec. Trav. Bot. Neerl.*, 25: 1–116, 1928.
[2] G. S. Avery, *Am. Jour. Bot.*, 26: 679, 1939; K. V. Thimann and F. Skoog, *Am. Jour. Bot.*, 27: 951–960, 1940.
[3] F. Kögl, A. J. Haagen-Smit and H. Erxleben, *Zeits. physiol. Chem.*, 220: 137–161, 1933.
[3a] F. Skoog and K. V. Thimann, SCIENCE, 92: 64, 1940.
[4] F. Kögl, A. J. Haagen-Smit and H. Erxleben, *Zeits. physiol. Chem.*, 225: 215–229, 1934.

and low protein wheats and in the isolation work from corn.

The procedure is briefly as follows: Dry whole wheat kernels are soaked for four hours in sodium hydroxide solution at pH 10.5, ground in a glass mortar with clean sand, allowed to stand at 20° C. for 45 hours (together with one ml of toluene) with the pH maintained at 10.5. At the end of this period, the mixture is centrifuged, and the supernatant liquid is tested by the standard Avena procedure.

Table I illustrates a typical experiment. The value obtained at pH 10.5 compares favorably with the amount of auxin recovered by the biological digestion method.

TABLE I

pH	Auxin per kilogram of wheat*
4.0	0.37 mgm.
7.0	2.25
10.5	6.96
11.5	1.50

* In terms of indole-3-acetic acid.

Temperature effects were also considered. Above 60° C. losses began to occur. The maximum rate of hydrolysis was found to lie between 35° and 40° C. However, since the rate was almost the same at 20° C., the investigation was carried out at room temperature in view of practical considerations involved.

Tests upon samples of corn showed the same effects of increased auxin activity upon standing at pH 10.5 as did the wheat. Yellow cornmeal, fresh from the mill, was found to be more convenient for isolation purposes and accordingly was used.

It was found that a 50 per cent. acetone-water mixture could be satisfactorily used for the hydrolysis. The ratio of solvent to cornmeal was adjusted to form a thick paste-like mass, and the pH was maintained near 10.5 for a period of 45 to 60 hours. After the hydrolysis period, the mass was pressed, and the residue was washed with a 50 per cent. acetone-water mixture. The filtrate, combined with the washings, formed the initial extract for the isolation. Addition of sodium chloride gave rise to the formation of a separate acetone layer; after separation, the aqueous residue was washed with acetone. The acetone solutions were distilled, and the distillation residues were combined and extracted with ether. The isolation proceeded from the ether-soluble material according to the general procedures already described in the literature for isolation from other materials.[4, 5]

The isolations gave as an end product a syrup which was physiologically active and which gave a color reaction with ferric chloride similar to that given by indole-3-acetic acid. Upon long standing this syrup crystallized. A portion of the material, when recrystallized, showed a melting point of 164–5° C. and no melting point depression on mixing with synthetic indole-3-acetic acid. This is proof of the identity of the isolated material with indole-3-acetic acid, and is the first time that indole-3-acetic acid has been isolated from higher plants. Since the amount of the isolated acid is many times greater than the auxin amount indicated by the normal extraction process, it undoubtedly represents a large part of the auxin present in bound form.

In addition to the indole-3-acetic acid, there was obtained a small amount of crystalline pseudo-auxin-a which melted at 196–7° C., with sintering beginning at 173°. Kögl, Koningsberger and Erxleben[6] give the melting point of pseudo-auxin-a as 193–4° C., with sintering beginning at 176°. This shows the presence of some auxin-a in the original starting material, which rearranged to pseudo-auxin-a during the isolation procedures.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN IMPROVED GAS BURNER FOR SMOKING KYMOGRAPH PAPER

WHILE experimenting with a protective "skirt" in order to decrease the susceptibility of the paper-smoking flame to air drafts, it was found that such a protective skirt can be made to yield very great improvements in other characteristics of the flame as well. Not only are draft sensitivity and flickering greatly diminished, but the flame also becomes far more efficient in smoke formation, becoming relatively cool, dull red and very smoky. The relative coolness has been found particularly valuable in the student laboratory, since we have found it practically impossible to scorch the paper with the new burner while using benzol enriched gas.

The essential improvement of the burner consists in surrounding the usual perforated delivery tube with a "skirt" in the form of an inverted V, open at the top and bottom, which serves the purpose of limiting the air supply to the flame. The amount of air drawn

[5] F. Kögl, A. J. Haagen-Smit and H. Erxleben, *Zeits. physiol. Chem.*, 214: 241–261, 1933.
[6] F. Kögl, C. Koningsberger and H. Erxleben, *Zeits. physiol. Chem.*, 244: 266–278, 1936.

in at the large lower orifice is determined by the ratio of upper exit area to gas volume, since the upper exit is responsible for back pressure from the gas passing through it. This critical ratio may be varied by adjustment of either gas flow or exit width, or both.

Several constructional details are important. The "skirt" is made of hard asbestos plates (sheet metal warps badly) attached to end-plates by single bolts, so as to permit adjustment by rotation of the sides. The end-plates are mounted upon the ends of the burner tube, the whole forming a chamber surrounding the flame and parallel to it. The upper orifice is situated about one and a half inches above the burner tube, and the lower orifice about an inch below this tube (not critical). All screw-heads on the inner surface must be countersunk, as the flame mirrors faithfully any such irregularities.

Because of the great improvement in uniformity of the flame it has been found advantageous to insure constancy of the paper surface during smoking. This has been accomplished by mounting adjustable uprights at either end carrying roller discs between which the drum shaft rests and rotates during smoking. The paper surface should not be nearer than about one inch from the upper orifice, as the amount of gray ash deposited increases with nearness to the flame exit.

In practice, the upper orifice must be made a little wider than that which yields the coolest and smokiest flame. This limitation is imposed by the fact that combustion can be made so incomplete as to deposit an admixture of gray ash along with the carbon.

With this relatively cool flame the carbon deposit possesses remarkably little adhesive power, consequently requiring very little writing-point pressure. However, this improvement carries with it the penalty that the deposit may be partially removed by the slight force of immersion in shellac solution, causing streaking. This may be entirely obviated by the simple expedient of floating the record on the shellac surface for a few seconds before plunging it in as usual, so that the carbon deposit is gently moistened by the liquid soaking through the paper, and is then not removed by subsequent immersion. Parenthetically, this same method has also been found to yield great improvement in the optical qualities of records smoked by the conventional flame. It appears that the initial submersion method removes a loosely adherent surface carbon layer, leaving a thinner and more shiny surface which is optically much poorer. This great difference may be very easily and convincingly demonstrated by "float wetting" only half of a record prior to immersion of the whole. The preliminary flotation wetting requires no appreciable increase in time, and is sufficiently complete as soon as the surface changes perceptibly, which occurs within a few seconds.

The author wishes to acknowledge indebtedness to Mr. William Darby for valuable contributions to the design, and to Mr. Henry Koch for the lay-out and construction of the finished instrument.

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OXIDATION PREVENTION

RAPID spoilage of photographic developing solutions by oxidation is common, annoying and expensive. The usual method for reducing such loss is by repeated transfer of the solutions as they are used up to successively smaller bottles, so that there will be a minimum of air between the liquid and the stopper. Such transfer is a nuisance and requires maintenance of a stock of bottles varying in capacity, each kept scrupulously clean, ready for filling and labeling.

A layer of cheap mineral oil an eighth of an inch deep will float on the top of developer in any bottle, will prohibit this destructive oxidation and will adjust its level to the volume of unused solution. Developer may be removed from below the oil or added under the oil by such a siphoning arrangement as shown. Developer may be induced to rise in the glass tube *A*

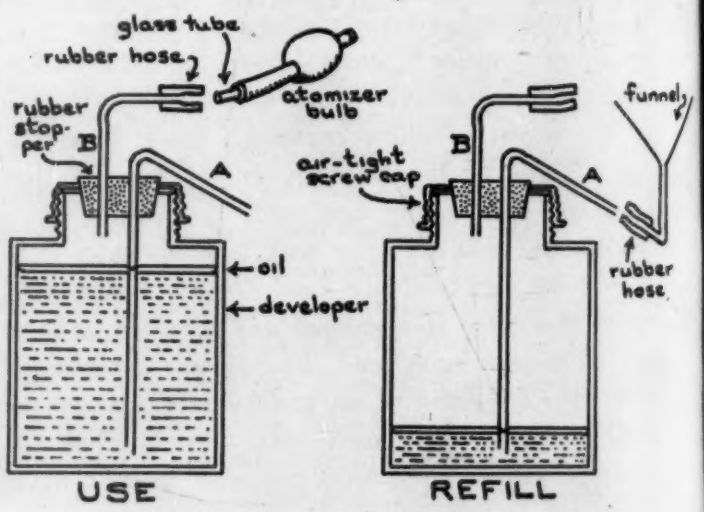

FIG. 1

and overflow into any container by blowing into the glass tube *B*. For such blowing, a cheap atomizer bulb may be "plugged in" to the *B* tubes of any number of such units, one after the other, and used to increase the air pressure over the developer. Unplugging the atomizer unit quickly releases the pressure and stops the flow. The only air–developer contact is in the tube *A* and is of negligible area. It is good technique to dry off the open end of tube *A* after removal or addition of solution since a drop will collect there, but otherwise there is nothing to wash, wipe, move or label.

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McGraw-Hill Books of Unusual Interest

Textbook of Dendrology. *New second edition*

By WILLIAM M. HARLOW, New York State College of Forestry, and ELLWOOD S. HARRAR, Duke University. *American Forestry Series.* In press—ready in January.

In simple, largely nontechnical language, this book describes the important forest trees of the United States and Canada. Nearly 250 species of trees are covered in detail, and most of the descriptions include distinguishing characteristics, general description, range, and botanical features. In the new edition a number of extensive changes have been incorporated to make the book easier to teach and easier to use.

Elementary Qualitative Analysis. *New third edition*

By J. H. REEDY, University of Illinois. *International Chemical Series.* 159 pages, 5½ x 8. $1.50

The revision of this well-known manual combines the advantages of the semi-micro and the macro techniques, while avoiding the limitations of each. The new edition also contains several other procedures: the new procedure for the Tin Subgroup; the use of alcohol in sensitizing the separations and tests in the Alkali Group; and a more definite procedure for the detection of the anions.

Experiments in General Chemistry. *New third edition*

By H. W. STONE, M. S. DUNN and J. D. MCCULLOUGH, University of California at Los Angeles. *International Chemical Series.* 285 pages, 8½ x 11. $1.60

The effectiveness of this successful manual has been considerably strengthened in the new edition by the elimination of certain assignments and the addition of others, together with a number of important changes designed to improve the experiments. New problems have been added to many of the assignments to adapt the manual more closely to the needs of the technical student.

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By RUEL V. CHURCHILL, University of Michigan. In press—ready in January.

This distinctive new book has a twofold objective: (1) to equip the student with that part of the theory of orthogonal sets of functions which is essential to the usual applications arising in the physical sciences; and (2) to give him a thorough knowledge of the classical process of solving boundary value problems in partial differential equations, with the aid of those expansions in series of orthogonal functions.

Soils and Soil Management

By A. F. GUSTAFSON, Cornell University. *McGraw-Hill Publications in the Agricultural Sciences.* 416 pages, 6 x 9. $3.00

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By J. A. STRATTON, Massachusetts Institute of Technology. *International Series in Physics.* 615 pages, 6 x 9. $6.00

Postulating Maxwell's equations from the outset, the author of this new book emphasizes dynamic rather than static field theory. A mathematical formulation of the general theory is followed by a comprehensive investigation of energy and stress relations. The properties of static fields are then discussed and the rest of the book is devoted to the propagation of plane, cylindrical, and spherical waves, the theory of radiation, and boundary value problems.

Methods of Study of Sediments

By W. H. TWENHOFEL and S. A. TYLER, University of Wisconsin. 180 pages, 6 x 9. $2.00

Here is a brief, nonmathematical, yet complete presentation of methods of study of sediments. Standard methods of sampling are described, methods of analyses are given, and various forms of graphical representation of the characteristics of sediments and sedimentary rocks are shown.

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SCIENCE NEWS

Science Service, Washington, D. C.

"GHOSTS" OF THE UNIVERSE

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TINY images of all the stars beyond one of extremely high density are "ghosts of the universe." They may be produced as the star bends light rays going past in a manner comparable to the way that a camera lens bends light rays from a scene and focuses them to form a picture on the film.

Speaking at Pasadena before the American Physical Society, Dr. Fritz Zwicky, of the California Institute of Technology, said that such images would afford a check of his theory of the ultimate fate of the gigantic star explosions called supernovae. When one occurs, a previously inconspicuous star suddenly rises to equal a hundred million suns in brilliance.

After such an explosion, which occurs on the average only once in several centuries in any one galaxy, such as our own Milky Way system, according to the theory, the end result is a collapsed neutron star. This would represent the lowest states of energy that matter could possesss without actually turning into radiation.

Because they would be so exceedingly dense, far surpassing even the "white dwarf" stars in which a cubic inch of matter might weigh millions of pounds, they could not be seen. The force of gravity would be so great that any light they might emit would not be able to get away.

That there is an effect of gravity on light was one of the predictions of the theory of relativity of Professor Einstein. It has been confirmed by observations of the sun, where the effect is so slight that very delicate measurements are required to detect it.

With the neutron stars so dense, light from a distant star of the normal kind passing near one would be bent through a large angle, as if through a prism. Where the light rays that have passed all parts of the edge of the neutron star meet, an image would be formed, so that the star would really act as a gravitational lens. The image would be seen, if at all, floating in space, between us and the neutron star. Images of other stars would also be formed, so, within a small ring, there would appear "a miniature edition of all the unobscured luminous objects in the universe." Dr. Zwicky said that if the neutron star is close enough, and in the right position, this image might be observed, suggesting that astronomers search for such images. Even if the details could not be seen, an analysis of the light might reveal its character, for the spectrum would be a combination of the spectra of many different kinds of stars. "If the neutron star theory of supernovae is correct the number of collapsed stellar remnants of supernovae in our galaxy would exceed one million, and several collapsed neutron stars may be expected within a sphere of ten light years."

Less than ten visible stars are now known to be within this distance.

THE SUPERNOVAE

(*Copyright, 1940, by Science Service*)

THE smallest pieces of atoms known to science may be responsible for the biggest star explosions—the "supernovae"—stars which suddenly flash out from relative obscurity to equal 100,000,000 suns. This theory is proposed by Dr. George Gamow, professor of mathematical physics at George Washington University, who worked out its details with the aid of a Brazilian scientist, Dr. Mario Schenberg. Neutrinos, they believe, are the cause. These are emitted from the nuclei of atoms, together with electrons, in one form of disintegration which happens with radium and similar elements. They carry away about two thirds of the energy released from the nucleus when this happens. Because they are so small and have no electrical charge, they have been most elusive.

Inside a star which has started to contract, the temperature would reach several hundred million degrees. Under these conditions processes that can never happen under earthly conditions would easily take place. An electron might hit the nucleus of an iron atom, converting it into a form of another element, manganese. This element, known as Mn–56, has been made artificially in the laboratory. In the process a neutrino would be given off. But the core of the Mn–56 atom would, in a few hours, turn back to iron, with the liberation of an electron, and another neutrino. Then another stray electron would change the iron back to managanese, again with a neutrino released.

Dr. Gamow says that there are dozens of analogous processes which would work the same way. As these worked to and fro, he says, neutrinos would be produced all the time. He said that "the neutrinos would penetrate without any difficulty through the body of the star and escape unobserved, carrying away the energy. The process provides for the unlimited cooling in the center of the star, and prevents the central temperature and pressure from rising above a certain value. It is thus clear that, when this process starts, the star must rapidly collapse under its own weight. The outer layers of the star, heated by the compression, will lead to a large increase of the observed luminosity, which will be registered by astronomers as a nova, or supernova, explosion. However, the radiant energy (light, etc.) emitted during such explosion will be but a small fraction of the total energy liberated in the collapse, since most of the energy escapes unobserved, carried away by the neutrinos."

Dr. Gamow pointed out that this agrees closely with astronomical data. These indicate that the energy detected by telescopic observations is much smaller than might be expected from such a collapse. He also explains the difference between ordinary novae, or "new stars," which get to be about 10,000 times as bright as the sun, and the brightest of the supernovae, which are ten thousand times brighter than the novae. It is due, he believes, to the fact that the stars have different masses. He finds that a mass 40 per cent. larger than the sun is a critical value. Above this figure the collapse is much more violent—result is a supernova. These great stellar explosions occur in our Milky Way system about once in three centuries. The last explosion of that type in our galaxy was that observed by Tycho Brahe in A.D. 1572. The previous one was observed by the Chinese in 1054.

BIOLOGY AND ZOOLOGY TEXTS TO HEAD YOUR LIST FOR 1941

Essentials of Zoology

The author brings into this book the essential fundamentals which every zoology student should have, regardless of the length of the course he happens to take. Some emphasis is placed on the economic aspect, on the human relation, and on the principles involved. The arrangement of the chapters has been placed in an order which seems logical. However, the chapters are written in such a way that the teacher may change the order with no difficulty.

By GEORGE EDWIN POTTER, Ph.D., Professor of Biology, Agricultural and Mechanical College of Texas, College Station, Texas. 532 pages, 204 illustrations. PRICE, $3.75.

Textbook of Zoology

This book brings several important advantages into the Zoology classroom. Not only does it present the usual routine material that is found in the college Zoology textbook, but it also presents it in a newer and more interesting way. Woven through this material are the theoretical and practical phases. In addition to the usual material this book presents many practical and interesting phases such as Regeneration, Animal Distribution, Wild Life Conservation, Animal Behavior, Etc.

By GEORGE EDWIN POTTER. 915 pages, 400 illustrations, 15 color plates. PRICE, $5.00.

Laboratory Outline for General Zoology

This book has been prepared as a guide to the laboratory portion of a course in elementary zoology. Although planned and arranged especially for use with the author's "Textbook of Zoology" the instructor may easily change the order to suit himself, and therefore the manual may be used with almost any textbook, or none. Sufficient study is outlined for a two-semester course, but for a shorter course appropriate portions may be selected.

By GEORGE EDWIN POTTER. 281 pages. PRICE, $1.75.

Laboratory Outlines of General Biology

The exercises in this manual are arranged to correlate closely with the author's textbook "Fundamentals of Biology." The exercises may be performed in two semesters, although the manual is so arranged that any parts may be selected for a one-semester course. The manual is divided into four parts: Introductory Biology — Animal Biology — Plant Biology — General and Applied Biology.

By WILLIAM C. BEAVER. 239 pages. PRICE, $2.00.

Fundamentals of Biology

This book offers the teacher many worthwhile advantages. It is large enough that it can serve both as a classroom text and at the same time contains a good deal of reference reading for the course in general biology. It has survey chapters on animals and plants in which a large group of organisms is given so that individual instructors can select those which in their opinion best illustrate the points they are trying to illustrate.

By WILLIAM C. BEAVER, Professor of Biology, Wittenberg College, Springfield, Ohio. 2nd Ed. 889 pages, 301 illustrations, 14 color plates. PRICE, $4.00.

Introduction to Vertebrate Zoology

The comprehensiveness of this book has been developed to the point where not only is there a large group of types described in all or in part but there is also a greater comprehensiveness on the individual types that usually are studied at a greater length. Where the study of anatomy used to compose the foundation and also almost all the super-structure of the course, this book now includes other phases such as embryology, classification, adaptation, evolution, etc. These additional phases add considerable life and interest to the course.

By WILLIAM HENRY ATWOOD, Head of the Department of Biology, Milwaukee State Teachers College. 511 pages, 264 illustrations. PRICE, $3.75.

Introduction to Animal Biology

This new book on Animal Biology has been made practical and applied. In its preparation, the student, his difficulties and his problems, as revealed to the authors by their teaching experience, have been constantly kept in mind. While at all times they have endeavored to make their exposition of facts and principles clear and accurate, they have ever borne in mind that they were writing for students to read and understand.

By JOHN B. PARKER, Professor of Biology, the Catholic University of America, and JOHN J. CLARKE, Assistant Professor of Biology, The Catholic University of America, Washington, D. C. 503 pages, 163 illustrations. PRICE, $3.75.

Laboratory Instructions in General Biology

The present manual is the result of years of experience in conducting laboratory exercises coordinated with and made an integral part of a course in general biology for beginners extending through the academic year and carrying with it three or four credits a semester. The manual is divided into two parts—Animal Biology and Plant Biology.

By JOHN B. PARKER and JOHN J. CLARKE. 148 pages. PRICE, $1.50.

C. V. MOSBY COMPANY

3525 Pine Boulevard **St. Louis, Missouri**

The Star of Bethlehem was evidently also a supernova of about 4 B.C.—JAMES STOKLEY.

URANIUM

(Copyright, 1940, by Science Service)

THE first determinations of the amounts of various elements produced by transmutation of uranium 235 in the breaking-up process by which it is hoped to produce atomic power have been made recently by Drs. A. V. Grosse, E. Fermi and H. L. Anderson, of the department of physics of Columbia University. Their results are announced in a report to the *Journal* of the American Chemical Society.

When the form, or isotope, of uranium known as U 235 is hit by a neutron, a tiny atom fragment, it breaks up into two pieces, which are different elements. Dr. Grosse and his associates find that the results of this division, or fission, fall into two groups, one of heavy elements, the other lighter ones. In the first is iodine, xenon, caesium, lanthanum and cerium; in the latter molybdenum. They have computed the proportions of each that will result from the fission of 100 U 235 atoms. On the average, the yield would be a little more than 50 of the heavy group elements, and about 6 of the lighter.

However, it is pointed out that the equation they have made to show the results "is as yet incomplete, for the fission of 100 atoms of U 235 will produce 100 atoms of the heavy group and simultaneously 100 atoms of the light element group (in addition to neutrons and energy). This indicates that the discovery of additional fission fragments is to be expected."

CUNNINGHAM'S COMET

HYDROGEN gas, never before recognized in a comet, has been discovered in Cunningham's comet, now visible in the western evening sky. This discovery, which radically changes the ideas of astronomers about the nature of comets, was announced by the Harvard College Observatory, where the comet was discovered in September. Up to the present carbon, oxygen, nitrogen and sodium have been the principal elements recognized in comets by analyses of their light. Except for the sodium, these have always been in compounds, such as carbon monoxide.

Studying one spectrum plate of the new comet, Leland E. Cunningham, discover of the comet, and his colleague, Dr. Fletcher G. Watson, have found dark bands that seem to show that a comet consists mostly of hydrogen.

Similar dark bands have been found in comet spectrum photographs before, though they have never been interpreted as due to hydrogen in the comet itself. It is planned to re-examine these old plates as soon as possible. With further exposure that may be made of the new comet, these may confirm the presence of hydrogen.

If it proves correct, the new discovery will be important in the interpretation of future comets. Any new clue to their birth will contribute to understanding better one of the major unsolved puzzles of astronomy, the origin and evolution of the solar system.

THE ELECTRON MICROSCOPE

NEW facts about the diphtheria bacillus, which that germ has hitherto kept secret from prying microscopes, have been discovered by Dr. Harry E. Morton, of the University of Pennsylvania School of Medicine, and Dr. Thomas F. Anderson, of the research laboratories of the Radio Corporation of America.

The electron microscope, which uses particles of electricity instead of light and magnetic fields instead of lenses allowing investigators to examine objects one fiftieth the size of anything heretofore visible, enabled Drs. Morton and Anderson to record the location of chemical reactions within the tiny diphtheria germ. They reported to the Society of American Bacteriologists that crystals of tellurium metal are formed from tellurite salts within the diphtheria bacillus.

The fact that the diphtheria bacillus and other microorganisms could reduce tellurite salts to black tellurium metal has been known since 1900, but in the case of the diphtheria bacillus it was not known where the formation of the metal occurred.

Crystals of tellurium are not only contained within many of the diphtheria cells, the electron microscope pictures showed, but in some cases the crystals perforate the cells and extend into the surrounding space.

"Occasionally," Dr. Morton said, "when the crystal projects through the cell the outline of the cell extends along the edge of the crystal a short distance suggesting that the cell 'membrane' was perforated from the inside outward. The tellurite crystals disappear upon treatment with appropriate chemicals."

SCIENCE IN 1940

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(Continued from December 27, 1940)

ENGINEERING AND TECHNOLOGY

The Pennsylvania turnpike, a 160-mile road without crossroads, was opened between Harrisburg and Pittsburgh.

The biggest steam turbine made since 1930, capable of 80,000 kilowatts, was completed.

New values of the viscosity of steam at high pressures and temperatures were made available.

The largest conveyor belt system carried 1,100 tons of gravel, sand and crushed rock per hour 9.6 miles to Shasta Dam.

A suspension bridge near Tacoma, Wash., was opened, becoming the third largest in the world, but a few months later it collapsed in a gale.

AERONAUTICS

A SUCCESSFUL helicopter made in the United States and an autogiro capable of vertical takeoff were demonstrated. A new interceptor fighter plane, capable of ascent at a speed of more than a vertical mile a minute, was demonstrated.

The Allison engine, America's principal contribution to the art of liquid cooled aircraft engines, was perfected to the point of going into quantity production in the General Motors Indianapolis plant.

Military airplanes attained speeds exceeding 400 m.p.h.

Air-cooled airplane engines developing more than 2,000 horsepower were developed.

The world's largest land passenger airplanes, with a

daytime passenger capacity of 42 passengers, weighing 25 tons and powered with four engines, went into production.

Air transport planes began to carry passengers in pressurized cabins above the weather.

The keel was laid for the world's largest flying boat, for the U. S. Navy.

Federal control of aviation was changed with the abolition of the Civil Aeronautics Authority and the creation of the Civil Aeronautics Board and the Civil Aeronautics Administration.

Military air service in the United States was aided when an air officer was made deputy chief of staff and a lieutenant-general was placed in charge of the G. H. Q. Air Force.

New aviation fuels that increase safety by reducing greatly the fire hazard, were developed.

An elaborate government program to train civilians as pilots was started.

Air service from the United States to New Zealand and Australia was inaugurated.

New air routes into China kept that nation in touch with the outside world despite invasion.

An airplane was for the first time certified by the government as being stall-proof and spin-proof.

A program to build large numbers of airplanes for U. S. defense was started.

New laboratories for aviation research were begun by the National Advisory Committee for Aeronautics at Moffett Field, Calif., and at Cleveland, Ohio.

MEDICAL SCIENCES

DEVELOPMENT of a new measles vaccine and its success in clinical trials on a small group of children was announced. New evidence of the importance of thiamin, or vitamin B_1, not only for preventing disease and minor degrees of ill health, but for increasing the alertness and capacity for physical work in persons of ordinary good health was obtained from diet studies on human subjects.

Lack of riboflavin, one of the B vitamins, in the diet was discovered to cause keratitis and cure of the condition by riboflavin was announced.

Synthesis of pantothenic acid, one of the B vitamins, and its identification as an adrenal gland-protecting factor for rats, and its usefulness in human nutrition were announced.

A new vaccine from influenza and distemper viruses was found to give ferrets solid immunity against several strains of influenza and was tried on humans during an epidemic in Puerto Rico but without definite conclusions.

A second virus cause of influenza, to be known as Influenza B virus, was discovered and found to cause epidemics in alternating cycles with Influenza A virus.

Sulfathiazole was announced as an improved remedy for pneumonia and as a valuable remedy for staphylococcal infections and as a possible cure for bubonic plague.

Evidence of regression of cancer achieved by treatment of patients with fast neutron rays from the cyclotron was reported.

Neutrons slowed down by boron proved five times as effective as fast neutrons in destroying cancer tissue in test-tube experiments and cured transplanted cancer in mice.

"Air bends" or aeroembolism, occurring in rapid ascents to high altitudes, can be prevented by oxygen inhalation treatment before taking off.

Signs of heart damage due to oxygen lack were discovered in flyers at altitudes as low as 5,000 feet.

A "pocket-size" emergency oxygen inhalation apparatus for parachute descents from high altitudes was devised.

Five groups of eye defects significant in certain types of work and new tests for detecting them were announced together with a theory of job selection on an eye-sight basis.

A serum for treating Rocky Mountain spotted fever was developed.

Two kidney extracts were reported to give relief from high blood pressure.

Isolation from soil bacilli of chemicals capable of destroying a large range of pathogenic micro-organisms and promising results with the use of one of them, gramacidin, in treatment of chronic bovine mastitis, were announced.

Successful vein grafting or splicing was accomplished with the aid of the anti-blood clotting chemical heparin.

Sulfanilylguanidine was announced as a promising remedy for bacillary dysentery and other intestinal infections.

Test-tube transformation, for the first time, of living mammalian cells into cells of apparently radically different type which may be cancer cells was achieved by methylcholanthrene treatment in search for the secret of the change of normal cells into cancer cells and suggested that a change in the cell membrane may be crucial to the transformation of normal to cancer cells under chemical treatment.

Cancer-causing substances, it was announced, have been extracted from the presumably healthy livers of cancer patients and, apparently for the first time, from human breast cancers.

A new route by which cancer cells and disease germs can spread through the body, by-passing the heart and lungs, and thus in the case of cancer giving a false sense of security in prognosis based on lung involvement, was discovered in the valveless vertebral veins.

Discovery that glutamic acid occurs naturally in both right-handed and left-handed forms refuted the idea that appearance of the left-handed form in the body was an indication of cancer.

Antibodies that can inactivate influenza virus were discovered in human nasal secretions and seen as a possible protection along with a change seen during influenza in the cells of respiratory mucous membrane of ferrets.

Cirrhosis of the liver in rabbits was produced by a diet lacking in a substance found in yeast and thought to be choline.

Evidence showing that the liver is of fundamental importance in the formation of prothrombin and in the metabolism of vitamin K was reported.

Aluminum treatment of silicosis in human patients was begun with early encouraging results.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE HEALTH OF THE PUBLIC DURING 1940

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IN my review of the mortality for 1939 I indicated that I anticipated no retrogression in the health of the public during 1940. It is gratifying to find that my statement has been essentially confirmed. While official statistics are not available for the total population, the experience of the Metropolitan Life Insurance Company with its millions of industrial policyholders can be used as a safe index of the general situation. For experience has shown that these insured men, women and children, living in all parts of the United States and Canada, form a very fair cross-section of the general public.

The record for the first eleven and a half months of 1940 shows that their mortality rate for the year will be slightly lower than for last year. Under such conditions the health of the general population of the United States can not be very different.

The year 1940 got off to a very good start. In the first six months the figures were, month for month, either the lowest or next to the lowest record. Beginning with the summer, however, when the excessive heat wave contributed to higher-than-average mortality, the death rates for several months ran somewhat above the figures for the past two years. But the month of November again showed the lowest mortality on record. At the time of writing indications were that December would also make an excellent showing, in spite of an extensive outbreak of influenza on the Pacific Coast and sporadic instances elsewhere. Fortunately, the type of influenza does not seem particularly virulent and, so far, has not resulted in any appreciable rise in deaths from pneumonia.

One of the most noteworthy features of the year's record is the marked decline in deaths from pneumonia. Each year since the extensive use of type-specific antiserums and the introduction of sulfanilamide and allied improved derivatives in the treatment of pneumonia, there has been a sharp drop in its mortality. Since these declines have occurred even in the periods when influenza was prevalent, we may expect that at last a method of control has been found for pneumonia, and look forward with confidence to the time when this disease will record only the negligible rates now in evidence for many of the other acute diseases.

The communicable diseases of childhood will register new low rates again this year, with three of them, namely, measles, scarlet fever and diphtheria, causing a death rate of less than one per 100,000. Even whooping cough will show a rate but little above this figure. Another children's disease even more important numerically is diarrhea and enteritis, which will also register a new low for 1940. When we realize that according to the mortality prevailing at the beginning of this century, one third of all persons born would eventually die from some acute condition, and that under present circumstances this ratio has been reduced to one sixth, we can appreciate the beneficial effects resulting from the progress in the control of diphtheria, pneumonia, diarrhea and enteritis and similar diseases.

It also appears that 1940 may be added to the long series of years which have witnessed continuous declines in the mortality from tuberculosis. There has been a considerable slackening in the rate of the fall, however. For many years past, the annual decreases have been sizable, but so far in 1940, the drop has been negligible, namely from 44.8 per 100,000 for the January–November period of 1939, to 44.3 for the like part of 1940.

A very favorable feature of this year's report is the further decline in the mortality of mothers during pregnancy and childbirth. The puerperal death rate for insured women is down 11.1 per cent. for the first eleven months of the year. The 1940 rate will be the lowest ever recorded.

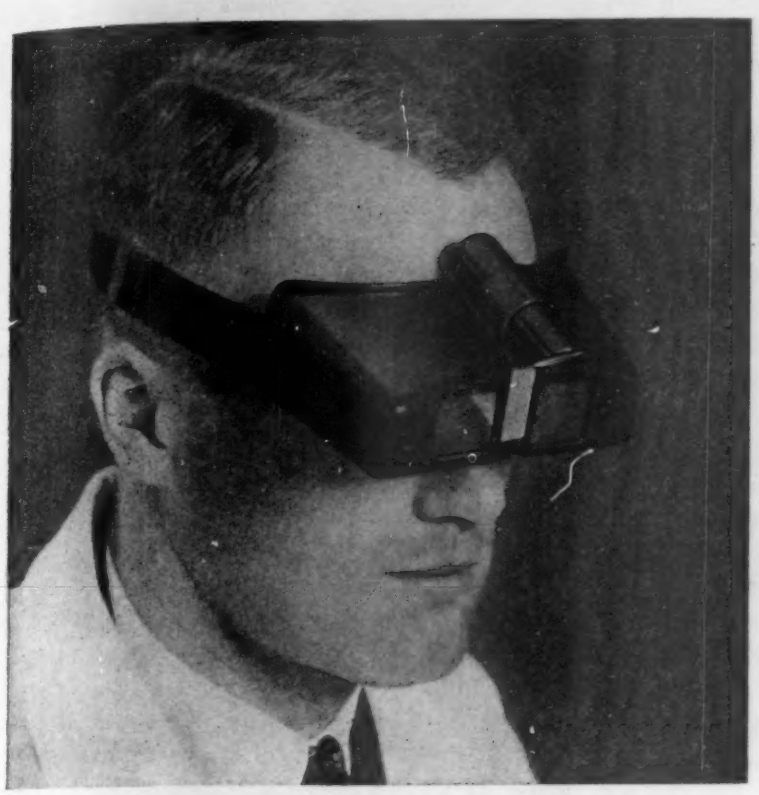
Now, having considered the favorable side of this year's mortality situation, to make the picture complete we must also note that there are certain diseases and conditions which we have so far failed to bring under control. These are mainly the chronic conditions characteristic of middle and later life, including diseases of the heart, kidneys, and arteries, and cancer, and diabetes. To a large degree, upward trends in mortality from these diseases are inevitable, simply because of the steadily increasing proportion of older persons in our population. Our resources in preventing or postponing the onset of these diseases and in curing them are quite limited. Despite this, it would be wrong to say that little is being accomplished.

As to cancer, early diagnosis and prompt treatment by surgery and radiation are increasing the number of cured patients. Diabetics, thanks to insulin, are living longer than ever before. Most of them are leading fairly normal lives and are able to work as well as other individuals of the same age.

The record for accidents is somewhat unfavorable. The increase in industrial accidents is probably a reflection of the speeding up of industry for national defense. In the last World War such an increase occurred. The entrance of large numbers of inexperienced workers into new occupations inevitably introduces its own particular danger. The urgent need of preparing for the safety of the nation may result in some sacrifice of safety for the individual. It is to be hoped, however, that industry will guard against any such tendency at this time, for it not only results in needless waste of human life, but also impedes the carrying out of the vital program of national defense.

Fatalities from motor vehicle accidents will exceed those reported in either 1938 or 1939, and may run as high as 34,500 for the country as a whole. The campaign for prevention of automobile accidents, which seemed to function so efficiently in 1938 and 1939, has not been so successful in the past year.

Considering the trend of mortality in recent years, it seems well assured that the public health will continue to



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improve along many lines during 1941. Whether the excellent record of the last few years can be repeated or even excelled will depend largely on two or three factors. In the first place, much will depend upon the extent of the spread of influenza now in evidence on the Pacific Coast and other isolated points and upon the continuance of it in a mild form. A wide-spread epidemic of a more virulent type of influenza would not only increase deaths from that cause, but would also increase mortality of the older people suffering from chronic conditions.

A second factor which must be considered in a forecast of the mortality of 1941 is the effect of the draft on public health. The bringing together of many individuals who have not established immunity against the more common communicable diseases will undoubtedly increase the incidence of such diseases. We must be prepared for a possible recrudescence of epidemic cerebrospinal meningitis such as we had in the draft of 1917 and 1918. Fortunately the introduction of chemotherapy has put us in a better position to handle this disease than formerly. Likewise the recently developed vaccines for influenza and the type-specific antiserums and chemotherapy for pneumonia should result in better control of the respiratory conditions.

A third factor which may affect unfavorably the 1941 mortality is the accident situation. As was noted before, the hazards resulting from the speeding up of industry for national defense must be guarded against to prevent an increase in such deaths.

However, in spite of these difficulties, which are very real, and which will require the best efforts of all those interested in maintaining the public health at a high level, I believe we can look forward to 1941 with confidence. We can continue to make progress in the saving of human life provided we take seriously our personal obligations to keep fit, and our community obligations to support our official and voluntary health agencies with sufficient resources to carry on their work effectively.—LOUIS I. DUBLIN.

PAPERS READ BEFORE THE AMERICAN PHYSICAL SOCIETY

DRS. ALEXANDER GOETZ and S. Scott Goetz, of the California Institute of Technology, reported to the American Physical Society that cells of brewer's yeast seem to act like giant molecules in a reaction with silver, affording an extremely delicate test for this and other metals. They gave a demonstration before the session, showing how the yeast cells could be used to reveal the presence of about three billionths of an ounce of silver. The test became possible after they had found a new method of staining the yeast cells. After this treatment the cells are examined under the microscope and those that have been killed by the metals can easily be distinguished from the others. By such an examination it is possible to measure the proportion of cells that the metals have affected. Using mathematical formulae, the amount of metal can be calculated.

IN the electric eel, there is an electric impulse in the animal's electric organ which travels from tail to head at a speed of half a mile per second, or even more, was reported by W. A. Rosenblith, of the University of California at Los Angeles, and Richard T. Cox, of New York University. These speeds, faster than any recorded nerve impulse, though far below the speed of electricity itself, were previously suspected, and have been confirmed by new measurements.

THOUGH the electron microscope, which takes pictures with electrons instead of light, has already been used to make magnifications as high as 25,000 times, a new method of using it may even increase its power. This method was described at the meeting by Dr. W. V. Houston and Hugh Bradner, of the California Institute of Technology. They use the microscope in two stages. First, electrons come from a filament similar to an electric lamp. These are focused by an electrical lens on a thin film which is to be magnified. The electrons passing through are then focused again by two magnetic lenses, either on a photographic plate, or a screen made of materials which glow with electron bombardment, and thus make the image visible.

PAPERS ON FORESTRY

THAT forestry, no less than manufacturing and agriculture, is an integral part of the national defense program and has an especially vital rôle to play in any unified program of land use, was pointed out by Ellery A. Foster, economist of the U. S. Department of Agriculture at the Washington meeting of the Society of American Foresters. "The new despotisms insist that our system is impotent to achieve a full use of science, a wise husbandry of resources, and full employment of labor. Their advocates say that we must forsake democracy in order to survive; that we must give unlimited powers to a dictator if we hope to compete." To meet this double challenge, the speaker continued, it is not sufficient to be alert and active on the federal front alone. State and private forces must carry a major part of the load, especially in the field of forest conservation and restoration. State foresters are offered unique opportunities to assist in upbuilding the national strength, Mr. Foster pointed out, because after years of being more or less ignored, they are now considered integral agents in land use planning in the majority of the states. And although this may look at first glance like long-range activity, many of its aspects have bearing on the immediate problems of the emergency.

FORTY years of development in state and private forestry were discussed in review by Austin F. Hawes, Connecticut State Forester, and John B. Woods, of the Oregon Forest Fire Association, respectively, who also made recommendations for future developments. Greater use of state forests for recreation was forecast by Mr. Hawes, who suggested that woodmen might be bidden to "spare that tree," even when overage or an obvious silvicultural misfit, if it is in the neighborhood of much-frequented recreation areas. He also suggested the desirability of a unit for measuring the usefulness of a given forest area for recreation—some such concept as "man-days of hunt-

ing or fishing,'' to enable administrators to measure more accurately such uses of the woods and thus to determine policy. Mr. Woods called the particular attention of foresters to the problems faced by private owners of woodland in seeking protection against insect pests, forest diseases and the fire menace. In general, he said, private owners ''have looked upon such problems as being beyond their power to solve. Yet they must be solved, somehow.'' He told how, in the Far West, groups of private forest owners pioneered in organization of regular patrols, cooperated to secure legislation making support of such activities compulsory upon all forest owners. Although federal and state forestry have since picked up part of the burden more than half of the fire-fighting expenditure is still borne by the private owners of timber tracts.

FIRE, for all the dread and devastation it creates in a forest, has played a vital rôle in forest development, according to D. K. Maissurow, of New Haven, Conn. Mr. Maissurow made detailed studies of trees in the great forested areas in northern Wisconsin. He found abundant evidence that there were great forest fires in that area long before white men came—as early as 1465. Other fires occurred in 1640, and were followed by development terminating in the present hardwood forest, now overmature and decadent. The rôle of fire, in undisturbed nature, seems to be very much like that of the lumberman with his ax and saw: it clears away tracts that have grown up to mixed hardwoods of uneven age, and lets new growth have a chance. In particular, the speaker stated, such natural fire clearance was responsible for starting the great stands of white pine, now mostly cleared away, that made fortunes for pioneer lumbermen, and provided a congenial seedbed for the Paul Bunyan legends.

PROPOSED CONSTRUCTION OF A SUPER-HIGHWAY SYSTEM

IMMEDIATE construction of an $860,000,000 superhighway system, extending the Pennsylvania Turnpike to Boston, Richmond, St. Louis and Chicago, ''is entirely feasible and practical,'' was discussed at the Detroit meeting of the Society of Automotive Engineers by Charles M. Noble, special highway engineer of the Pennsylvania Turnpike Commission.

''The highway engineer,'' he stated, ''is prepared to solve the engineering problems, the construction industry is equipped to execute the construction with economy and dispatch, but the program can not be started until the legislator and the financier solve the problem of low interest and bond discount rates; for these rates will determine the fare the motoring public must pay, and it may be stated with certainty that the fares must be moderate in order to attract a sufficient volume of traffic to assure the success of an express highway system.''

The system is the proposal of the Honorable Walter A. Jones, chairman of the Pennsylvania Turnpike Commission. From the present western terminus, east of Pittsburgh, would extend two branches. One, passing north of that city, would continue to Chicago, and its route would also go near Toledo and Cleveland. The other branch, to the south, would go close to Columbus, Dayton, Cincinnati and Indianapolis, then to St. Louis. A cross route from Indianapolis to Chicago is suggested. From the east, a line is proposed to Philadelphia, which would cross, west of the city, another stretch from Boston to Richmond.

Mr. Noble explained certain points of the proposal as follows: ''The initial system as proposed by Mr. Jones can be built and will be built if the great body of motorists, truck and bus operators, business and financial interests support the movement with determination and intelligence. It is hoped that the bus and truck industry will extend its support and cooperation to the movement. As stated previously, it would be preferable if express routes could be financed out of present motor vehicle revenues and thrown open to the public free, without requiring the user to pay a service fee for the greatly improved facility, but the situation in the several states is such that this does not appear possible now for any reasonable time in the future. Thus, I repeat, a choice must be made between doing without the facilities altogether or of accepting the principle of charging the actual users a service fare for the privilege of utilizing the benefits offered by an express highway system.''

ITEMS

TRANSFER of heat by liquid is familiar to any one who lives in a house with hot-water heating. The water is heated down in the cellar and piped to radiators where it gives up its heat to warm the room. Many industrial processes make use of similar processes, but liquids other than water are often used, because they can be heated to a higher degree before they turn into steam. Therefore, a considerably greater amount of heat can be transferred. A melted mixture of salts, especially the nitrates and nitrites of sodium and potassium, has been recently devised for the purpose by three du Pont chemists, W. E. Kirst, W. M. Nagle and J. B. Castner. This can be used for temperatures between 290 degrees and 1,000 degrees Fahrenheit. Below this maximum the mixture is quite stable and can be used for years, but above 1,000 degrees there is a slow decomposition. The first extensive use of the new compound, which is known as HTS, is in the Houdry catalytic cracking process, for oil refining.

FARMERS can produce milk more economically by putting cornmeal into their silos along with the grass silage that is rapidly becoming one of the agricultural standbys of the country. For consumption by cows, it doesn't need to be the kind of cornmeal that goes into muffins. Cobs and all may be ground up, state W. H. Peterson and associates of the University of Wisconsin. The cornmeal serves as a preservative for the grass and other herbage with which the silo is filled, replacing the molasses or phosphoric acid commonly used, which the farmer has to buy for cash. It doesn't do quite as well, it is explained, but is a ''good-enough'' material to use, if there is corn on hand for the purpose. Another material which gives promise as an ensilage preservative is whey, a by-product of the cheese industry. It can be used either in the powdered form or as soured whey concentrate. However, whey powder as at present marketed is too expensive, and the soured concentrate is not yet available.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE PRODUCTION OF STEEL

WHETHER the steel industry, which reaches flexible fingers into many other industries, can step up its output in time with defense tempo and at the same time reduce its cost of manufacture is a vital problem. Some economists hold that the cost of making a ton of steel is practically the same whether the plant is running at 80 per cent. capacity or at only 50 per cent. At the Chicago meeting of the American Statistical Association reports presented by Dr. Mordecai Ezekiel and Miss Kathryn H. Wylie, economists of the U. S. Department of Agriculture, state that analysis of the records kept by the United States Steel Corporation indicate that stepping up production from 50 per cent. to 80 per cent. of capacity actually decreases the unit cost of production about seventeen per cent. to nineteen per cent.

Labor costs per ton of steel decrease materially as the output is increased. When a plant is operating at only 20 per cent. of its capacity, it takes 56 man-hours of labor to make a ton of steel. If the output could be stepped up to full capacity, the labor per ton would amount to only 32 man-hours. Output per additional man-hour is about three times as great at 90 per cent. capacity as it is when the plant slows down to only 40 per cent. capacity.

It is pointed out that "If this relation is found to hold true in other mass-production industries such as automobiles, cement, aluminum, etc., material revisions may be required in much of current economic theory to make its assumptions consistent with the facts of a major part of modern industry.

"Our defense planning," Dr. Ezekiel and Miss Wylie conclude, "requires such information about our major industries that it may be most effective. Since steel is one of the major raw materials of defense, knowledge of the cost functions in that industry is particularly important. The prices which the government will pay for steel might be directly related to costs at different levels of output. Excessive profits might easily result from inadequate knowledge of these relations. On the other hand, the industry might be adversely affected by the adoption of an unduly low price structure without adequate knowledge of these relations."

The steel industry is in a peculiar position in regard to the balance of increased purchasing and lowered prices, according to Dr. W. Gregg Lewis, of the University of Chicago.

The railroads as large purchasers of steel were cited by Dr. Lewis as an example of this dislocation. Since the railroads do not sell steel products but services, he explained, the amount of their purchases depends upon the amount of travel or shipping and not upon the price of steel.

The question was raised by Dr. Lewis as to whether the timing of railroad purchases might not be adjusted to periods of low steel prices, regardless of the fact that amount of purchase is independent of the price to be paid. He pointed out that "There is practically no evidence in the historical record that the railroads have followed such a policy. The decisions required are apparently longer run than the railroads have been willing to make. When traffic and income are low, replacement pressure is also low. The short-run policy of postponing replacements is followed. When traffic is high, replacements become necessary almost without regard to price." In fact, he said, there is in general a perverse tendency in steel buying. Price advances generate expectations of further price advances and cause increases in purchasing and over-accumulation of inventories. Price declines have an opposite effect.

AUTOMOTIVE ENGINES

THAT defense may be endangered by the number of special oils that have been developed to meet the demands of a particular engine, class of design or service, was suggested by R. J. S. Pigott, of the Gulf Research and Development Company, at the closing session of the meeting of the Society of Automotive Engineers.

In the past five years, he said, a situation has developed that, "economically, is thoroughly unsound."

Charging that chemists have been called in to solve problems that really belong to the engineer, he stated that the chemist should be called as a last, not the first, resort.

"A considerable number of oils have been developed," he said, "which show improvement in some desirable characteristic, but by no means in all. Further, these oils generally work in a particular engine, class of design, or service, much better than the earlier oils; but in no case of which we are aware do they fit all cases. For example, an oil with additives to suit one design of Diesel engine may not be satisfactory in another design, nor serve for heavy-duty gasoline engines (truck and bus service). At the same time many Diesels and many heavy-duty gasoline engines are getting along perfectly well on high-grade, straight mineral oils.

"It looks as if the program is getting to be prescription oils for too many cases. Look at the defense situation a moment. The Army and Navy will want not over four oils for *all* engine purposes, and they would be glad to use less. How can they possibly handle 15 or 20 prescription oils for particular designs? The answer is, of course, that it can not be done, and it won't be done.

"When almost any kind of engine trouble occurs, the first thing blamed is the oil; next, the fuel. A long while after the smoke clears away, sometimes the design is reconsidered. The net result of this unthinking procedure is to throw into the lap of chemists many problems that ought to have been handled by the engineers themselves. Usually (and quite naturally) the decision is to call for a special oil if there is trouble; any fault of the design, especially the oiling system, is generally overlooked."

In summarizing his comments on lubricants, Mr. Pigott made the following points: (a) Unnecessary high bearing temperature is the major factor in present lubrication

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problems and the hurried development of an army of special oils. (b) Oiling systems can be, and for the future, must be, designed, not whittled. (c) Bearings must be made rigid enough to function at full advantage, and oil flows must be great enough to do the necessary cooling at reasonable temperatures for the oil. (d) External coolers should be used. (e) The mania for very light oils and completely "drying up" the engine should be reconsidered. (f) While compound oils are here to stay, "it is certainly bad judgment to keep calling for more and more special products, when what is needed is adequate designing to avoid that call." (g) Crankcases should be designed to drain dry.

Turning to fuels, Mr. Pigott pointed out that during the past 10 years the improvement in engine horsepower has been 20 per cent. due to increase in compression ratios following improvements in octane rating of gasoline, and 80 per cent. due to straight engineering design. If high horsepower is desired, he stated, supercharging is a good way to get it without going to synthetic chemicals for costly high octane gasoline. It costs millions, he said, to increase octane number a couple of points. He suggested that if supercharging is adopted "full intercooling should be used to cut down work for compression, lower terminal temperature to ward off detonation, and deliver a denser charge for high horsepower."

DIESEL ENGINES

AUTOMOBILE manufacturers can protect their own business and also help save our way of living, if they will organize for mass production of Diesel engines needed by the Navy and for other defense work, members of the Society of Automotive Engineers were told recently by Lieutenant Commander M. M. Dana, of the U. S. Navy.

The high-speed, light-weight Diesel for naval use differs but little from the automotive engine, he said, announcing that the Navy "has ambitious projects for its wider application in the future." He noted, however, that the present emergency is making severe demands upon the present source of supply and "it becomes necessary to attract other engine builders whose production facilities are not yet fully utilized." He presented the rating diagram, on which each engine is completely defined as to basis of rating.

These data for a number of modern Diesel engines now in use in the Navy, were also shown, as was a table of modern German light-weight Diesel engines.

Professor Eugene H. Fezandie, of the Stevens Institute of Technology, predicted increased adoption of Diesel power in many automotive fields.

Lower specific weights will be obtained for all classes, he said, through special materials and reduction of overall dimensions for a given power. In the case of the open-chamber type Diesel, he added, it is expected that no large increases of speed are likely and that the best opportunity for weight reduction will be in the two-cycle performance.

Improvement in combustion control and economy with existing fuels, Professor Fezandie remarked, will be looked for from the engine designer, while some progress in fuels for limited fields of use requiring this will be expected. He also stated that better lubricants will be necessary if higher power per cubic inch of displacement is to be attained without impairing engine life.

Meanwhile, he averred, the gradual reduction cost per horsepower should open up new fields of application where high-use factor, moderate-load factor and safety are important considerations.

Professor Fezandie compared the automotive Diesel with its stationary prototype and listed its pros and cons in relation to the gasoline engine. In the latter comparison he stated that the Diesel uses somewhat cheaper fuel (at present) and considerably less of it for the same power developed. The Diesel's handicaps of high first cost, weight, smoke and odor, high maintenance costs, lack of curb service, rough idling and hard starting, are being steadily reduced.

PARACHUTES

A NEW device has been developed for the parachuters of the U. S. Forest Service. It is a sturdy line, attached to the airplane. The cord breaks as the jumper makes his leap and automatically releases the rip cord.

Successful tests, made recently at Missoula, Mont., indicate that it is virtually fool-proof and may be of great value to the newly organized parachute corps of the Army. The Forest Service is obtaining a patent on the static cord. With the approval of the Civil Aeronautics Authority, whose official representative has witnessed the tests, it will be made standard equipment with the service. It is expected to eliminate the most difficult part of training, the teaching of the proper time to pull the rip cord.

It is pointed out that "Men jumping from an airplane under present conditions are required to trip their own parachutes in the conventional way. This has not been satisfactory in the past, as it takes much training for a novice to learn just when to open the 'chute. This is dangerous. If the jumper hesitates, he may project himself forward or snap backward; and if he jerks too quickly, he may open the 'chute into the tail of the plane with fatal results. Always there is the hazard that the jumper will 'freeze' from fear and fail to open his 'chute.

"The new parachute eliminates this danger," according to officers of the Forest Service. "All the jumper has to do is leap from the plane, whereupon the giant umbrella opens almost immediately, clearing the plane with plenty to spare."

THE SMOKE NUISANCE AND SOUND WAVES

IT may be possible for Pittsburgh, St. Louis and other smoky cities, in the not-too-distant future to get rid of the smoke.

The special studies division of the United States Bureau of Mines' metallurgical division is quietly perfecting a means of clearing contaminated atmosphere by means of high frequency sound waves.

Experiments with laboratory equipment at the new experiment station at the University of Utah, have been so successful that Dr. R. S. Dean, chief engineer of the metallurgical division of the Bureau of Mines, stated

recently in an interview that he foresees the day when the device will be commercially possible to be attached to every important chimney in a city, even down to individual homes.

Salt Lake City, where Dr. Dean has his headquarters, also has a smoke problem in winter. Near by are smelters and mines which will be practical proving grounds for the device.

In laboratory tests, conducted by Hillary W. St. Clair, assistant metallurgist, the device has completely cleared smoke-laden, dust-filled and otherwise contaminated atmosphere. The biggest stumbling block to making the device commercially practical was an effective and efficient source of high-frequency sound. This has been found.

A twenty-three pound aluminum cylinder is the vibrator and automatically operated at the best frequency. The sound waves produced are so intense that the radiation produces a pressure that can be felt against the hand even when it is held eighteen inches or more from the vibrator. It is capable of supporting small objects such as a penny or lead shot in midair.

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Problems remaining to be worked out are those pertaining to continuous operation on smoke in motion and the vibration of air or gas at certain frequencies.

INFANTILE PARALYSIS

THE fight to save America's children from infantile paralysis, or at least from its crippling after-effects, is being waged with every weapon medical scientists can devise. These weapons in the anti-polio armory range from rats to respirators, it appears from the annual report, just issued in New York, of the National Foundation for Infantile Paralysis.

The value and use of respirators, popularly known as iron lungs, is so little understood that the foundation in the past year spent some of its money, received through the President's Birthday Ball celebrations, to publish and distribute a pamphlet telling the proper use of iron lungs and listing the exact location of approved ones. "As the result of such information, it was possible in the epidemics this year to shift these costly machines from one territory to another, and thus avoid the purchase of additional respirators—the continued necessity of which is at least highly questionable."

Breeding a strain of disease-free cotton rats for laboratory investigations, such as testing the value of possible chemical remedies for infantile paralysis, was carried on with financial support of the foundation.

The search for new weapons continues. Spraying the nose with chemicals did not succeed as a method of preventing attacks of infantile paralysis, but the problem is being studied now in an effort to find out "exactly what takes place when infection does occur by the nasal route."

Food has been suggested as a possible weapon against polio. Very little is known at present about the relation of nutrition to infantile paralysis or other virus-caused diseases, so a grant of $37,500 was made by the foundation to the School of Medicine of the University of Texas to investigate this angle.

Of all the activities supported by the foundation, the largest sum, $189,562, went for educational activities during the year covered by the report. Included in this was the $70,000 granted to the National Research Council for fellowships for training investigators.—JANE STAFFORD.

ITEMS

THE U. S. Forest Service has reported at the close of its annual stock-taking that deforested lands greater in area than the whole of Italy still await replanting with trees. The total tree-stripped land amounts to seventy-seven million acres, of which only three millions are owned by the government and seventy-four millions are held by private owners.

THE U. S. Department of Agriculture has found that deer in the Kaibab National Forest, north of the Grand Canyon of Arizona, have materially benefited by the introduction of a carefully controlled hunting season, during which shooting of does as well as bucks is permitted. It was in this area that some years ago a terrible famine occurred among the deer because a completely closed season plus destruction of mountain lions and other predators had permitted their numbers to increase far beyond the capacity of the food plants to support them. During the 12-day shooting season, the record buck taken weighed 280 pounds dressed. In 1937 the record was 247 pounds; in 1932 only 207 pounds. Seventy-five of the bucks killed this season weighed more than 200 pounds dressed, and 40 had antler spreads of from 30 to 41 inches. Does shot this season constituted less than two fifths of the total number of animals killed. The number of deer to be killed is determined each year in order to maintain the herd in balance with the carrying capacity of the range, with the result that winter deaths through starvation and disease are avoided.

THE European greenhouses that used to supply much of the American market for rare and exotic blooms have been cut off from the American market and the American orchid-raising industry has not yet been developed sufficiently to meet the full demand. As one result, orchids sent by collectors direct from their native homes in the tropics are having something of a boom. That this has its own drawbacks is pointed out by E. R. Sasscer, of the U. S. Bureau of Entomology and Plant Quarantine. Orchids grown in European greenhouses are usually free from pests and diseases, whereas those from the tropics must be very carefully inspected to see that they do not bring in any of their considerable assortment of the insects and fungi that prey on them in their native state, lest these get loose and wreak havoc in American greenhouses.

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SCIENCE NEWS

Science Service, Washington, D. C.

ANNUAL REPORT OF THE SECRETARY OF AGRICULTURE

"THERE is no room in the Western Hemisphere for any notions about racial superiority." This counter challenge is thrown into the faces of "New Order" race dogmatists by Henry A. Wallace, now vice-president of the United States, in the midst of the biological and economic discussions that occupy his last annual report as Secretary of Agriculture. Speaking with the authority of his first-hand knowledge of genetics, which had gained him recognition before he entered into public life, he lashes unsparingly at doctrines that would rearrange the world on a master-and-slave basis:

"Theories of racial superiority and racial inferiority have no scientific basis. Certain nations may be very different by training from other nations; by inheritance they are probably little different. Millions living in Germany are different from us chiefly because of an indoctrination systematically instilled into them from early youth. They have had more training in hard work, in giving their all to the fatherland, and in submission to economic and military rule. Many of them believe war is holy and think the achievement of German domination justifies any means. But if numerous American children had been adopted into German families twenty years ago, they would be just the same. They would be indistinguishable from native-born Germans. Probably any favorably located race can develop a civilization. The Indians of Latin America did so. Civilizations of long ago in Africa, China, Japan and India were not inferior in many respects to those of to-day. In this hemisphere, broadly speaking, we have democratic types of civilization, and they rest on a genetic basis."

In the report, much emphasis is placed on the necessity for adjusting American agricultural production to the existing market. Pre-war measures taken by practically all the nations anticipating the outbreak of hostilities had sharply diminished our old export markets, especially for wheat, cotton and tobacco, and the events of the war have cut still further into possible outlets for those crops. On the other hand, home markets for such things as meats, dairy products, fruits and vegetables are steadily improving.

In the presence of this situation, Mr. Wallace points out, "Growing unneeded crops is sheer waste of labor, of capital and of soil, even if temporarily the products can go into storage under government loans. It is a drain on resources that would otherwise be available for national defense."

Better trade relations with other Western Hemisphere nations are recommended in the report. Obviously, the United States can not import from South America commodities of which it already has surpluses, like Argentine wheat or Brazilian cotton; for these, joint effort in seeking sales outlets would seem to promise more satisfactory results. In the meantime, there is plenty of room in United States markets for a whole array of products whose very names suggest the exotic: abaca, cinchona, kapok, rotenone, tea, cocoa, camphor, rubber, tropical hardwoods. Most of the North American demand for these things is now supplied from the Old-World tropics; and even so, that demand should be capable of considerable further growth.

MYTHS OF NORDIC SUPERIORITY

MYTHS of "Nordic superiority" fare ill at the hands of Dr. Aleš Hrdlička, the physical anthropologist of the Smithsonian Institution, who has just completed a study of the heads of one hundred and fifty of America's leading scientific men. Far from being long-headed blonds, this group of outstanding American scientists tend to be wide-headed and their hair (so far as they have any left) is decidedly dark.

The group included in the study were chosen from the membership of the National Academy of Sciences. This body, sometimes referred to as the Senate of American science, elects to its membership only persons of proved accomplishment and reputation in the various fields of science. Naturally, most of its membership is middle-aged and elderly—few men less than fifty years old are elected.

The high average age of the members accounts in part for the predominantly dark hair color. Every one's hair grows darker as he grows older. It also explains the qualification of his statement, that a high proportion of the academy members have (or had) dark hair.

Fifty members of the group studied were of foreign birth or immigrant ancestry. The remaining one hundred were "Old Americans," that is, of families who have been three generations or longer in this country. These "Old American" scientists tend to have larger and wider heads and darker hair than the average of "Old American" men in the general population. They also have decidedly less prominent cheekbones.

Another myth that suffers from this study is that of the "highbrow." Eminent scientific men don't average more prominent foreheads than do other men, the measurements show. Neither do scientific leaders have massive heads on stoop-shouldered, pindling bodies: the general physique is full-grown and sturdy. This, it is pointed out, is largely a matter of nutrition. Men with their brains and training get good jobs and keep them.

Seven per cent. of the group have decidedly back-sloping foreheads—another traditional "sure sign" of inferior intellect. This has nothing to do with the brain content of the skull. A sloping forehead is usually due to larger-than-ordinary sinuses over the eyebrows, giving a wider base rather than a narrower top. Even when the slope is due to other causes, however, it does not necessarily mean any inferiority of the brain.

One member of the academy has the head of a Stone Age man. This does not mean, however, that he is a beetle-browed Neanderthaler—far from it. His head is like that of the Aurignacian people, who left remarkable

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paintings and sculpture in the caves of southern Europe. Aurignacian men had larger heads and bigger brains than moderns. The type still crops up occasionally in Scandinavia and among certain groups of American Indians. They may be considered a survival of, or perhaps a reversion to, the earlier type of our common ancestry.

REPORT OF THE U. S. BUREAU OF PLANT INDUSTRY

ABILITY of the United States to get along on its own, or to replace former dependence on the Old World by mutual aid between peoples of the Western Hemisphere, is emphasized in the annual report of the Bureau of Plant Industry to the Secretary of Agriculture.

An outstanding influence of such intra-hemisphere aid is the announcement that new kinds of wheat from Brazil are showing high resistance to leaf rust and some degree of resistance to stem rust as well. These wheats are being used as breeding stocks in producing rust-resistant wheats for growing in the Southwest.

The Biblical maxim that "man shall not live by bread alone" receives practical exemplification in the production of new, American-produced Easter lily bulbs, to replace the stocks heretofore imported from Japan. The new American lilies can be grown so far out of season that they can be brought into bloom for use at Thanksgiving time as well as at Easter.

Possible plant sources of poison for insects that eat other plants are being investigated by the bureau. Most promising are new strains of the rustic tobacco plant (*Nicotiana rustica*) which produce several times more nicotine than is obtainable from ordinary tobacco. Another is the native seashore plant known as devil's shoestring, which yields rotenone, at present extracted from East Indian derris and South American cube.

Further declaration of independence of foreign sources is proclaimed in such diverse fields as fertilizers, sugar-beet seed and tung oil. Magnesium for mixed fertilizers used to be imported from Germany; chemists of the bureau have shown how to use an American magnesium compound with satisfactory results. For potato fields, domestic muriate of potash is shown to be a good substitute for imported (and more expensive) potassium sulfate.

During the last war, the American beet-sugar industry found itself in a bad way for lack of foreign-grown beet seed, on which it had become dependent. The Bureau of Plant Industry insisted on the development of an American source of seed, and sugar-beet growers have reason now to be glad they did.

Efforts to grow the Chinese trees that yield tung oil have run into some difficulties because of their sensitiveness to cold. This, the report states, is mitigated when the trees are in a fully dormant state at the onset of the cold wave.

Cold-resistance seems to be possible also in the tropical Hevea rubber trees that have been the subject of breeding experiments at the bureau's experimental farm at Coconut Grove, Florida. So well have Hevea trees thriven there that the bureau scientists have been able to pull a coals-to-Newcastle stunt—they have sent some of the seeds grown there for planting in tropical American countries.

WILDLIFE CONSERVATION

WILD animals that live in the woods don't like their woods too complete. Not the "deep tangled wildwood" of oldtime poetic fancy, but a mixture of old and young trees, full-grown timber and open spaces with plenty of brush, makes up the ideal forest from the wildlife standpoint, Ira N. Gabrielson, chief of the U. S. Fish and Wildlife Service, points out in a new book, "Wildlife Conservation," off the presses recently (Macmillan).

This seeming paradox is easy to explain. Tall trees in completely closed ranks, such as one finds in a mature virgin forest, bear their leafy canopy high in air, where not even a giraffe, let alone a deer or moose, can browse on the foliage. Furthermore, the tops are so tightly interlaced that very little light can seep through to support a ground population of herbs and shrubs that would afford food to game birds or mammals.

The ideal situation, where profitable timber yield and support of wildlife are sought simultaneouly, can be achieved either by selective cutting, where only chosen trees, ripe for the ax, are taken out each year, or by clean cutting of quite small blocks of timber distributed through the forest. Either method provides a constant succession of well-scattered spots where young trees and underbrush provide browse and shelter. The Forest Service even instructs its men not to plant in certain limited acreages that appear to be more useful as homes for wildlife than as fields for future crops of timber.

Mr. Gabrielson of course does not confine his attention to problems of wildlife in the forest. His book is a comprehensive and well-balanced study of what is to be done with America's outdoor resources—grasslands, deserts, mountains, streams and lakes, as well as woods. He reviews abuses of the past, and tells how they can best be remedied—are already being remedied in many places.

It isn't just a matter of providing picnic grounds for vacationers, game to hunt and fish to catch for sportsmen. There are potential cold cash values of major proportions in wildlife restoration. The raw fur take in the United States was once worth a hundred million dollars a year. What the meat might have been worth, in the days of game abundance, there is no way of estimating. But if we could restore even a fraction of the venison and wildfowl and fish that the early settlers knew— and wasted—there can be no doubt that there would be eager and profitable markets for them.

RARE ACIDS

THE European war has caused a spurt in the production of rare amino acids at the University of California at Los Angeles, according to Dr. Max Dunn, associate professor of chemistry.

Dr. Dunn operates a non-profit company, Amino Acids Manufacture, with the assistance of M. J. Stoddard. The company, formed by Dr. Dunn in 1935 shortly after he first began his study and found that only a few of the twenty-three acids were produced, is one of the three organizations of its kind in the United States.

Since then Dr. Dunn has been able to produce nearly all the acids, and he sells these to laboratories and medical clinics all over the world.

The chemist knows amino acids as constituents of proteins but in appearance they look like bath salts crystals. They are manufactured from a variety of substances such as glue, human hair, dried cottage cheese, dried blood, etc. Some of them are so difficult to produce that they sell for $1,000 a pound—worth twice their weight in gold. The acids, which seldom occur free in nature, make up the protein of man's hair, skin and fingernails.

"Amino acids are no longer coming through from Germany and Switzerland," said Dr. Dunn, "and we are getting about twice as many orders as before the war."

Amino acids are used for a number of purposes. One kind is used as a flavoring for soups and gravies and has a surprising meat-like taste. Other types of amino acids are used in medical research on baldness, cancer and muscular diseases. Amino acids are already used in treatment of such disorders as gastric ulcers and muscular ailments.

SYNTHETIC RUBBER

THAT synthetic rubber can not "be universally substituted for the natural product," was reported to the Society of Automotive Engineers by L. B. Sebrell and R. P. Dinsmore, of the Goodyear Tire and Rubber Company. It is, they stated, "a material having special properties which, when properly handled, will give improved results as compared with natural rubber. On the other hand, we should look upon it as a material whose development and perfection will liberate us from the threat of embargo of natural rubber during the time of national emergency and as a guarantee that the price of the natural product will never again reach the peaks which have characterized it in the past."

Although synthetic rubbers possess elasticity and resilience, they differ considerably in molecular makeup, and it ought not to be expected that they will process just the same way as natural rubber. This study is limited to synthetic rubbers capable of vulcanization.

By far the most serious aspect of the successful use of these rubbers is their difficult processability. For severe service in tire treads, certain synthetic rubbers were recommended by the authors, who added that they can not, at present, be expected to equal natural rubber. None of the synthetic rubbers is the equal of natural rubber in rebound. Synthetic rubber can not be substituted for natural rubber on a quantitative basis or on an equal cost basis without examining carefully the physical properties which are to result from such a procedure. There are also encountered various difficulties in substituting synthetic rubber for natural rubber. Typical compounding results for several vulcanizable synthetic rubbers in two different formulas were given, as were tabular data on dynamic tests.

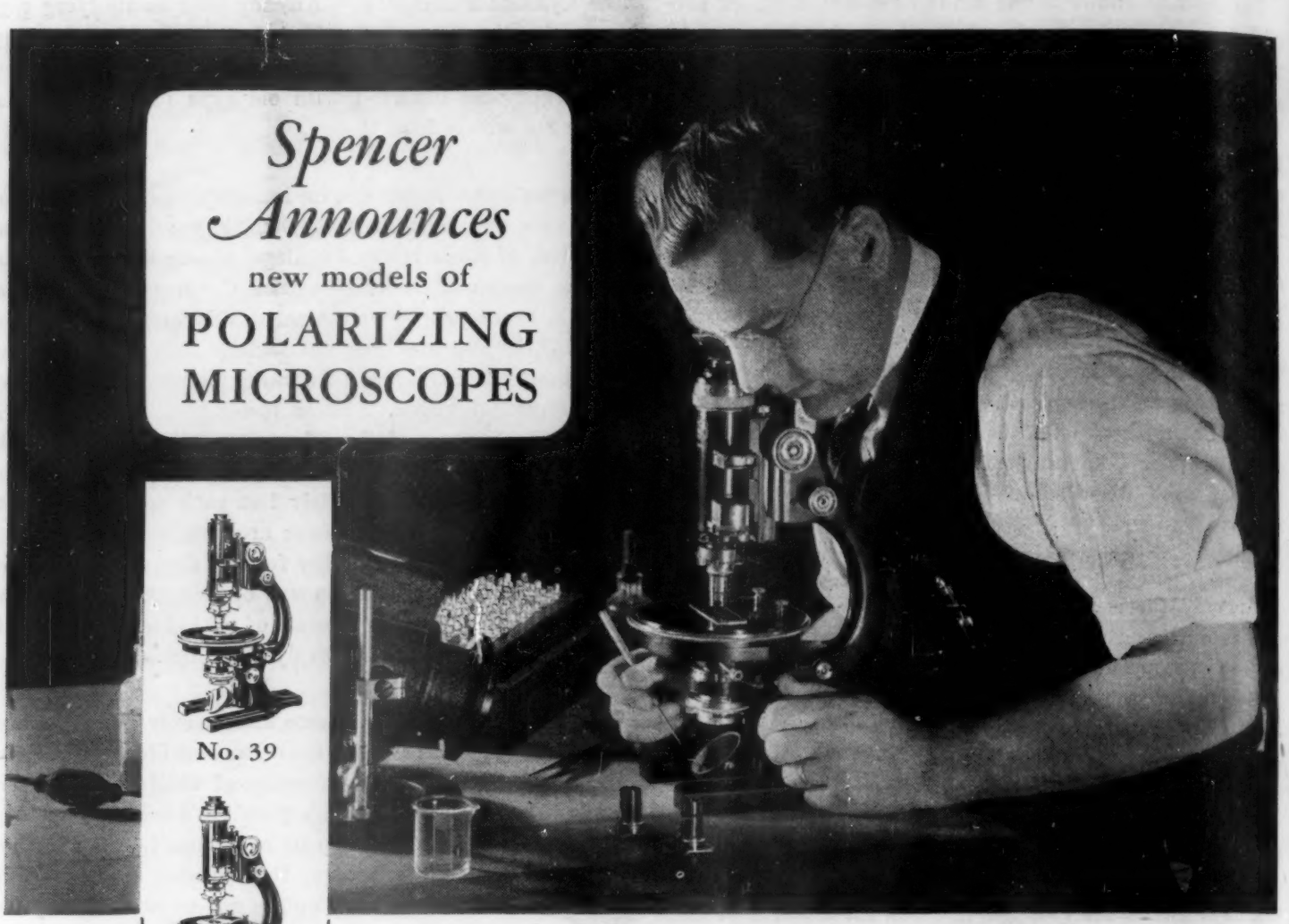
ITEMS

THE first American commercially built electron microscope—an instrument capable of magnifying 100,000 times—is now in use at Stamford, Conn. Constructed by the RCA Research Laboratories in Camden, N. J., the new super-microscope, which takes pictures with electrons instead of light waves, is in the laboratories of the American Cyanamid Company. Already used in studying pigments for the paper industry, it has shown that the very minute particles have the same crystalline structure as the larger ones observed with old type microscopes, disproving a widely held theory.

PREVENTABLE accidents in industry cause the loss of 2,000 eyes and more than $50,000,000 yearly, Dr. Thomas D. Allen, of Rush Medical College, Chicago, stated at the closing session of the third annual Congress on Industrial Health, sponsored by the American Medical Association. The $50,000,000 loss does not include such indirect losses as subsequent reduction in earning power of the worker with impaired vision. These losses, Dr. Allen and Dr. Henry F. Carman, of San Francisco, estimate, are probably four times as great as the direct loss. Besides the 2,000 eyes that are completely lost each year in preventable industrial accidents, there are 300,000 eye accidents which incapacitate the worker for one day or more. Suitable goggles are the best means of protection, Dr. Allen said, because about 80 per cent. of all industrial accidents involving the eyes are due to flying bodies.

A MOSQUITO species hitherto known only from Panama has appeared on the coast near Brownsville, Texas. Dr. Frank W. Fish, of the University of California, who has made a study of the insect's peculiar habits, conjectures that it may have traveled to its new home by plane. Fortunately for human beings, the invader is exceedingly retiring, does not bite man and is not known to carry any disease. Its larvae or "wigglers" live in the holes made in the beach by the innumerable fiddler crabs that swarm along the Gulf shores. The adults prefer to feed on cold-blooded animals, and mate in confined spaces. The insect is known to entomologists by the technical name *Deinocerites spanius*.

A NEW instrument for telling in advance of treatment whether the eyes of a cross-eyed person can be straightened to work together as a seeing unit was announced by Dr. J. F. Neumueller, director of the Bureau of Visual Science of the American Optical Company. The instrument gives the diagnosis in half a minute. The test with this instrument is based on the phenomenon of the after-image and on the fact that normal eyes can definitely locate objects in space. If the eyes and brain are unable to do this, as determined by the after-image test, normal visual functioning can not be restored. The after-image tester consists of a glass tube containing an electric wire. The current is switched on and as the wire glows the patient looks through one eye only at a red dot on the center of the tube. The tube is then turned from its horizontal position to a vertical position and the patient looks at the red spot through his other eye. Then the light is turned off and the patient, both eyes now open, looks at a fairly bright wall. Soon he notices two dark lines, the negative after-images. If these two lines form a cross, his cross-eyes can be successfully treated. But if the two lines do not meet, chances of restoring binocular vision are said to be remote.



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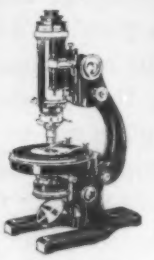
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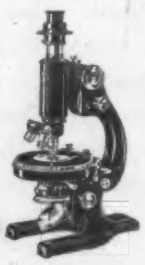
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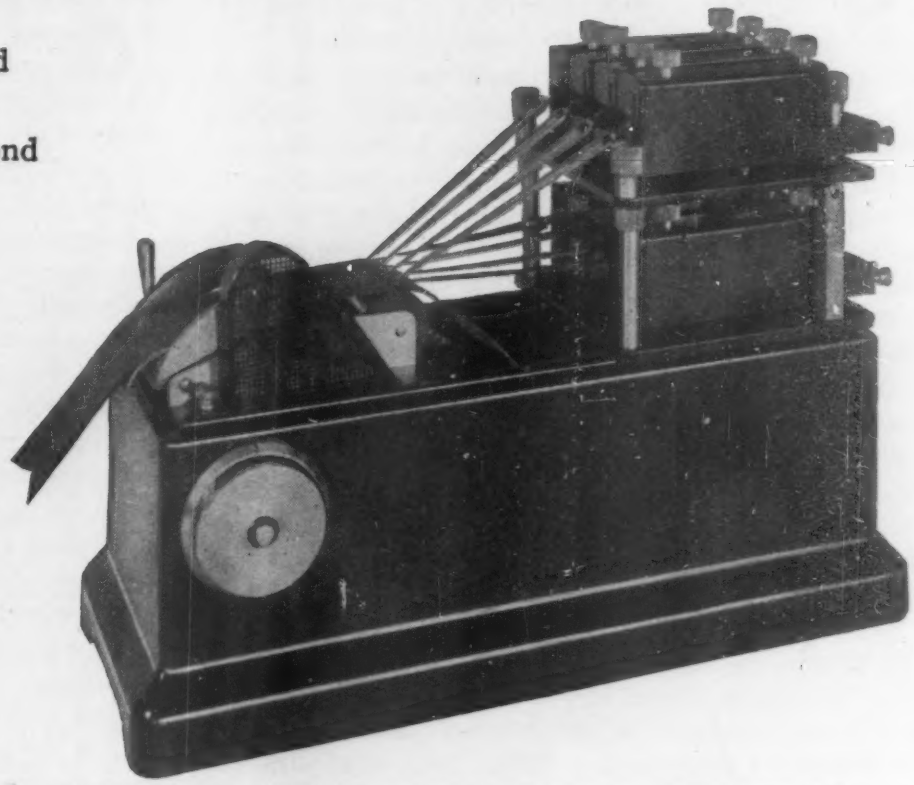

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SCIENCE NEWS

Science Service, Washington, D. C.

THE SEPARATION OF TWO FORMS OF KRYPTON

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THE most astonishing news from Germany, since the start of the war, has just been received in Pasadena. German investigators can now separate Uranium 235 from Uranium 238 if the information contained in the newly arrived issue of the scientific magazine *Die Naturwissenschaften* is correct. This is of first importance because, for one thing, Uranium 235 can serve as a substitute for, and improvement over, coal and oil, in many ways.

The article from which these conclusions are drawn does not mention Uranium. It is about the separation of Krypton 84 and Krypton 86 from ordinary Krypton. The authors, K. Clusius and G. Dickel, of the University of Munich, are the leading German workers in this field and they are responsible for the most powerful methods so far achieved for separations of this sort.

The mildly interesting but purely scientific experiments on Krypton become wildly exciting when it is realized that the separation of Krypton 83 and Krypton 84 is essentially the same in difficulty as the separation of Uranium 235 and Uranium 238. Both pairs differ by about one per cent. in weight. Heretofore similar results have been obtained only with lighter elements such as Neon 20 and Neon 22 or Chlorine 35 and Chlorine 37 where at least a 5 per cent. difference exists between the forms to be separated.

Actually the first Uranium separation was accomplished in the United States about a year ago but the quantities involved were so small that only a scientific interest applied to the work. At the rate of production of the American workers it would have taken centuries to produce enough Uranium 235 to weigh even on a chemical balance.

Judging from the results on Krypton the German workers, by last October, could have produced about one gram of separated Uranium 235. This would have been smaller than a pea but it could supply as much energy as several hundred gallons of gasoline. Moreover the apparatus, while 150 feet high, is not bulky or expensive and could be reproduced quickly.

The achievement involved in this work is so surprising that it must not be accepted without considering the possibility that something is wrong about it. It would, for example, be a perfect propaganda hoax to produce the feeling of invincibility of Germany. However the eminence of the authors and the established reputation of the magazine would be sufficient, in normal times, to warrant the reliability of the announcement.—R. M. LANGER.

ULTRAVIOLET RAYS AND REPRODUCTION

THAT ultra-violet radiation, usually considered inimical to life, proves a stimulant to reproduction in primitive one-celled green water plants when applied in less than lethal doses, is demonstrated by the experiments of Mrs. Florence Meier Chase, of the Smithsonian Institution.

Ultra-violet rays of certain specific wave-lengths are now widely used in hospitals and elsewhere to rid the air of bacteria. Earlier researches by Mrs. Chase showed that the invisible rays had similarly deadly effects on her primitive green plant cells. But when the same kind of plants are exposed to the same ultra-violet wave-lengths for about two thirds of the time necessary to kill them, instead of dying they multiply at greatly increased rates.

Increased reproduction rates differed according to specific wave-lengths. Mrs. Chase found four wave-lengths biologically effective: 2352, 2483, 2652 and 2967 Ångstrom units, respectively. Each of these wave-lengths increased the cell-division rate in a quite definite ratio.

Green cells exposed to the stimulating dose of the 2352-Ångstrom rays multiplied 4.7 times faster than a control culture of unirradiated cells of the same kind. The 2483-Ångstrom wave-length rays stimulated cell multiplication to 3.9 times the normal rate, and the 2652-Ångstrom wave-length rays produced a stimulation to 4.65 times normal. Least stimulation was brought about by the longest (2967-Ångstrom) wave-length: 1.62 times normal.

Although the green cells increased their numbers thus rapidly under the influence of ultra-violet radiation, the size of the individual cells in the stimulated cultures became much smaller than normal, as if the cells could not take time to grow up before they were hurried into reproduction.

A NEW COMET

THE third comet of January, 1941, already of the second magnitude and easily seen in the southeastern morning sky from countries south of the equator, may soon be visible from northern countries. An exact prediction of its future path, however, will be possible only with calculations that can not be made until more observations are available.

According to Dr. Harlow Shapley, director of the Harvard College Observatory, it was discovered by Dr. John S. Paraskevopoulos, Greek-born astronomer in charge of the Harvard southern hemisphere station near Bloemfontein, South Africa.

A report has been received from Dr. Enrique Gaviola, director of the Cordoba Observatory in Argentina, that two members of his staff, F. J. Bobone and M. Dartayet, determined its position in the early morning hours of January 24. Then it was in the constellation of Ara, the altar, a group never visible from most parts of the United States. It was of the second magnitude, easily visible without a telescope, and had a tail longer than a degree, which is twice the apparent diameter of the full moon.

The comet was moving, with speed enough to take it ten times the moon's diameter each day, to the northeast, which is towards the sun. Since these bodies are brightest when nearest the sun, Paraskevopoulos' comet will presumably become even more brilliant than it is now. Possibly, after it has passed the sun, it will come into view from the northern hemisphere.

Senors Bobone and Dartayet found the new comet only a few days after they had made some of the first southern observations of Cunningham's comet. This was the one, also discovered by a Harvard astronomer, that reached naked-eye brightness in the western evening sky about Christmas, though it did not become as conspicuous as astronomers had hoped. It has passed the sun, and is now in southern skies, so residents of southern lands now have the unusual privilege of two naked-eye comets at once.

First comet of 1941 was the Friend-Reese object, independently discovered by two amateur astronomers, one in California, the other in Pennsylvania. Dr. George Van Biesbroeck, of the Yerkes Observatory, found the second, when he picked up Encke's periodic comet on one of its return visits.

ASTROLOGY

ASTROLOGY, the tenets of which hold that the stars and planets exert an influence on human events by which predictions may be made in advance, is denounced as lacking every conceivable scientific foundation as well as being psychologically harmful, in a report issued by the Boston and Cambridge Branch of the American Association of Scientific Workers.

It was prepared by a committee of which Dr. Bart J. Bok, associate professor of astronomy, Harvard University, is chairman, and Mrs. Margaret W. Mayall, research associate, is secretary. Methods and claims of the astrologers are briefly summarized, and reasons given why they are not accepted by scientists. The complete report will be published in an early issue of *The Scientific Monthly*, organ of the American Association for the Advancement of Science.

"An interpretation of the rules laid down by astrologers demands the existence of an unimaginable mechanism of action," it is stated. "Astrologers have not provided us with as much as a sound hypothesis that might serve as a basis for their speculations. Astrologers attempt to offset this lack of a sound working hypothesis by the introduction of terms and concepts that are unknown to physicists and astronomers. No one, with a high-school training in physics, should be fooled into accepting an explanation of the laws of astrology in which the term 'cosmic vibration' figures prominently.

"Scientists would feel justified in considering astrology as a legitimate field of scientific inquiry if astrologers could claim that its basic rules had been established through a rigorous study of correlations. This is not the case. The rules by which astrologers interpret their horoscopes have not been derived from any known experiments or observations. Astrologers frequently claim the observational basis to be in the experience of forgotten generations far back in antiquity, but pure superstition can claim as sound a basis. In the cases of planets discovered in our times (Uranus, Neptune and Pluto) the evidence is conclusive that their influences on men were ascribed by the astrologers before preliminary observational tests of the influences could have been made, and even before accurate orbits could be assigned to the planets."

The committee quotes a statement prepared by the Society for the Psychological Study of Social Issues. In this, it is said, "Faith in astrology or in any other occult practice is harmful in so far as it encourages an unwholesome flight from the persistent problems of real life. . . . It is against public interests for astrologers to spread their counsels of flight from reality."

Though no careful, extended, statistical study of the success or failure of astrological predictions, which might prove a decisive test, is known ever to have been made, statistical tests of the supposed broad influences of the planets and zodiacal signs have failed to verify these claims.

Until such correlations are established, the report concludes, scientists can not accept the precepts of astrology. They can do a valuable service to society by pointing out publicly that the predictions lack any conceivable scientific foundation.

DIET IN SULFANILAMIDE TREATMENT

THE kind of food eaten by patients being treated with sulfanilamide may have an important bearing on the results of the treatment, whether or not the sulfanilamide causes toxic effects, it appears from research by Dr. M. I. Smith, Dr. R. D. Lillie and Dr. E. F. Stohlman, of the U. S. Public Health Service and National Institute of Health.

If the patients get too little protein food, such as meat, eggs and milk, they may be more likely to experience toxic effects from the drug, but the drug may be more effective because of reaching higher concentrations in the blood when the dietary protein is low, it appears.

Rats were the patients in the National Institute of Health studies. A low protein diet (7 per cent. protein) increased their susceptibility to sulfanilamide "by increasing the mortality rate and the incidence of anemia as compared with similarly treated rats on a diet containing 30 per cent. protein."

The concentration of the drug in the blood was somewhat higher in the rats on the low protein diet which, the investigators say, "may possibly account for the greater toxicity. This also raises the interesting question as to whether this might not be more than offset by the obvious advantages of higher concentrations of blood sulfanilamide in the therapeutic (remedial) application of the drug."

ELECTRIC ARCS ON HIGH VOLTAGE POWER LINES

LESS than a hundredth of a second is the time taken to put out accidental arcs on high voltage electric power lines provided with new switching devices described at the Philadelphia meeting of the American Institute of Electrical Engineers, by George A. Matthews, of the Detroit Edison Company.

These devices, it is expected, will greatly reduce the number of cases in which arcs, started by lightning, wind storms, and other uncontrollable conditions, burn the wires in two and allow them to fall to the ground. The high-speed devices will also eliminate the unintended blowing of high-tension fuses but will cause them to blow when the nature of the trouble warrants it.

Arcs between wires of overhead electric distribution lines result from several different causes, he explained. Lightning, high winds causing the wires to swing together, boys throwing baling wire and metal coat hangers across the lines, radio antennas and broken tree branches are examples. Where the line conductors consist of bare wires, arcs are readily started. If the wires have the so-called weather-proof covering on them, the likelihood of an arc is somewhat less under some of these conditions; but, if the covering is old and chafed, or when it is rain-soaked, the probability of an arc in the covered wires is practically the same as on bare wires.

A small wire like a radio antenna that falls across the line also results in a transient fault because the foreign wire is immediately destroyed by the arc. If, however, the cause of the arc does not disappear at once, the fault is persistent. Examples of this type are tree limbs that do not burn away immediately, heavy metal objects that can not be destroyed promptly by the arc, or conditions where the line wires become firmly wrapped around each other. Operating records show that well over half the faults that occur on overhead lines are of the transient type.

Ordinary switches do not work fast enough to prevent damage, but the new ones, which can be hung on the poles, take as little as 1.120 seconds to operate. One type is a complete automatic switch in itself, automatically performing all the operations necessary when dealing with faults of different varieties and serving to reclose the circuit when the trouble has passed.

DEMONSTRATION OF TELEVISION BY THE RCA

TELEVISION pictures projected on a theater screen 15 by 20 feet, from a projector in the balcony sixty feet away, were demonstrated by RCA engineers to show the Federal Communications Commission the latest advances in this field.

In order to use the greatest possible amount of light, a projector is used which is really an astronomical camera of the Schmidt type in reverse. The seven-inch face of the high voltage kinescope, on which the picture is formed, faces away from the screen, towards a 30-inch concave mirror. This reflects the image through a glass plate to correct certain faults or aberrations, then to the screen. By the method used for rating camera lenses, the system has a speed of F. 0.7.

The commission was also shown a home television receiver in which the pictures were projected to a screen 13½ by 18 inches. This used a conventional type of high-speed lens, treated, however, with non-reflecting films, to reduce light losses.

Some of the views witnessed were transmitted from the RCA mobile television unit, stationed at Camp Upton on Long Island, 68 miles away. Automatic relays, at Hauppauge and Bellmore, picked up the short range signals and passed them along. A new horn type antenna was used to receive them, in the relay towers and finally in a window on the sixty-second floor of the RCA building.

Radio facsimile, by which a newspaper complete with illustrations can automatically be printed in a home receiver, reproducing the original in the broadcasting station, can be combined with simultaneous broadcasts, on the same wave-length, was also shown.

The facsimile was broadcast with ordinary "amplitude modulation," in which the waves are the same distance apart, but vary in their height. The same carrier was given frequency modulation, by which the distance between the waves is changed in step with the sound vibrations. At the receiving end, the two were sorted out, and each used to operate the proper receiver.

ITEMS

To topsy-turvy developments in world turmoil, add the vote of American archeologists to send $2,000 to help the Greeks hide from bombs treasured antiquities, which archeologists were busily digging up before outbreak of the war. The American School of Classical Antiquities, in Athens, the donor, has practically abandoned digging. Members of the school still in Athens are studying in comparatively peaceful libraries and making discoveries—such as forgotten letters by the famous Heinrich Schliemann who opened the ruins of Troy. Greek officials, who have already stored much statuary and other ancient art in caves, vaults and other hideouts, have a trebly hard task. Funds are limited. Greece is so rich in antiquities that only Egypt and Italy could claim to rival it. And the limestone on which Athens and other Greek cities are built does not encourage tunneling of deep subways or other underground shelters. The limestone does provide caves, and they are useful.

AN instrument for making movies of stars has been built by Dr. Robert R. McMath, director of the McMath-Hulburt Observatory of the University of Michigan. In a report to the American Astronomical Society he told of the newest telescope for these pictures. They will show sunrise and sunset on the moon, the spinning of Jupiter and the movement of his moons around him and other heavenly motions. The new telescope is a memorial to his father, the late Francis C. McMath, who helped establish the observatory as an amateur institution more than a decade ago. With a smaller instrument, they first made such pictures. Later, however, they became particularly interested in motion pictures of the sun, from which remarkable new facts have been learned. Now Dr. McMath has announced that for educational purposes they will make such pictures again, retaking many earlier subjects with the new and more powerful equipment.

COLCHICINE, the drug that speeds up evolutionary processes in plants by doubling chromosome numbers, may be dangerous if not handled with proper precautions, according to Dr. Haig Dermen, of the U. S. Department of Agriculture. Animal tissue is much more sensitive than plant, to the effects of colchicine. A minute quantity of the solution, of the concentrations used on plants, might cause blindness, or might produce skin irritation. Up to the present at least, colchicine has had no scientifically valuable effects when used in attempts at producing new varieties of animals.

Bacillus S. paratyphi, magnified 12,000 diameters

Lacquer pigments, magnified 27,000 diameters

FROM RCA LABORATORIES COME

Radio Eyes FOR MICROBE HUNTERS

Anthony van Leuwenhoek of Amsterdam was the first to peer into the universe of the infinitesimal. With his crude microscope, he discovered in 1683 the "small beasties" which Pasteur and Koch —and Theobald Smith later branded the most dangerous enemies of man—the germs of disease.

BUT there are micro-organisms too small for optical microscopes to detect. These instruments operate by visible light, which cannot resolve objects much smaller than the wavelength of the light. Bacteriologists have been able to see only the larger microbes. They have been able only to hope that somewhere, somehow, an instrument would be found that would magnify not 1,500, but 20,000...50,000...100,000 diameters!

Scientists in RCA Laboratories have engineered such a microscope. They studied the electrons active in radio and television, whose length was but a tiny fraction of that of a light wave. Research proved these electrons could be used as "seeing" rays. Focused by powerful magnets upon photographic film, they would reveal what had hitherto been invisible.

Research is Radio's Road to Progress

RCA's contribution to the development of the electron microscope is the result of a far-seeing policy laid down by the founders of the company in 1919: *that fundamental research must be the keystone of every activity of RCA.*

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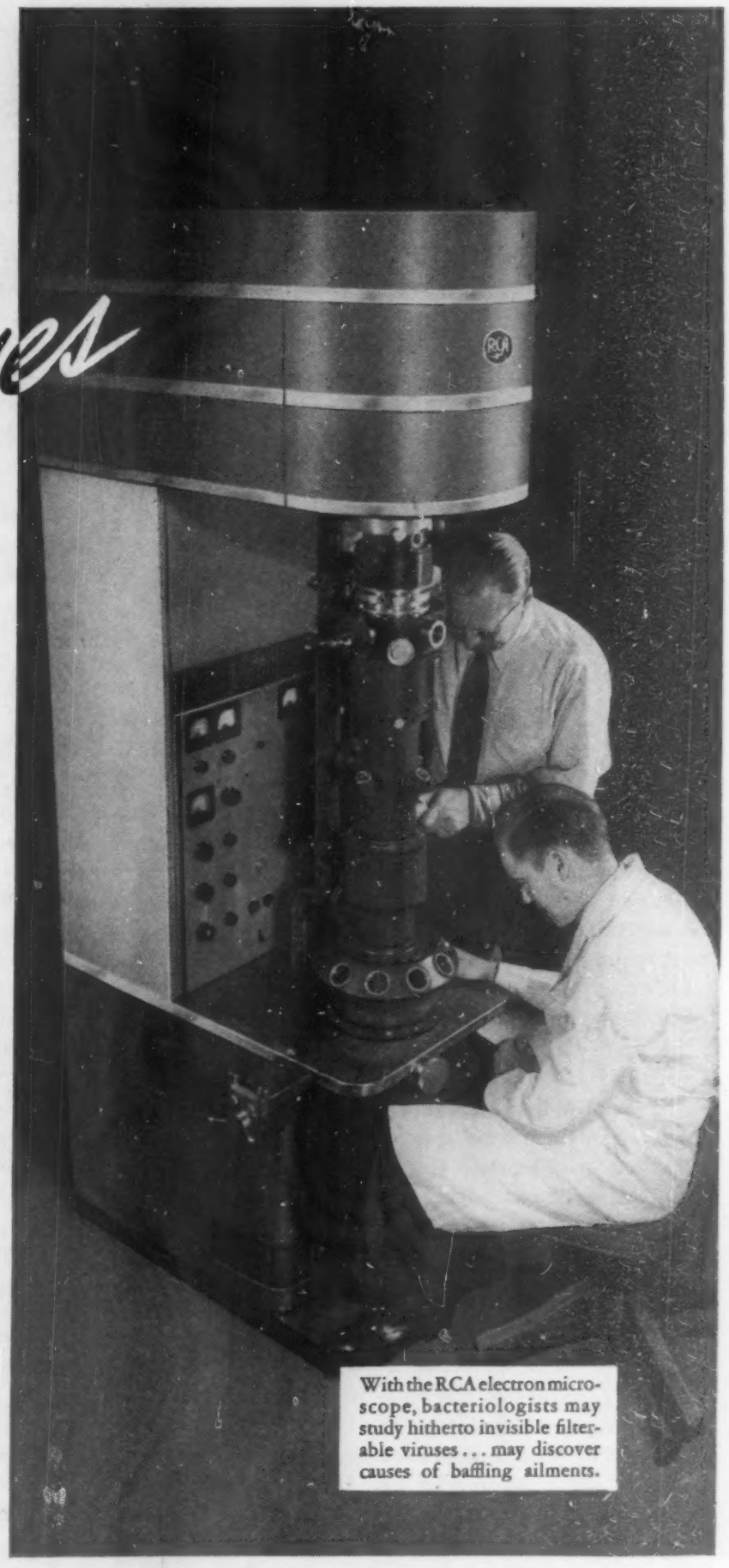

With the RCA electron microscope, bacteriologists may study hitherto invisible filterable viruses... may discover causes of baffling ailments.

RADIO CORPORATION OF AMERICA

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME PAPERS READ AT THE PHILADELPHIA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES

Egg-shaped stars, which sometimes are more stretched out, at other times more nearly spherical, were described by Dr. Theodore E. Sterne, of the Harvard College Observatory, before a meeting of the American Astronomical Society. These are stars known as eclipsing binaries. Such a system consists of two separate bodies, revolving around each other in a sort of cosmic waltz. When one comes between us and the other partner, the total light reaching us is reduced. No telescope is powerful enough to show the two separately, but their presence can be deduced from the way the light varies, and from analysis of the light with the spectroscope. The tidal pull of each star on the other stretches it, so they are never exactly spherical, said Dr. Sterne. As they rotate, they present varying amounts of their surface to observers, depending on whether we see the egg on end or sideways. This causes additional variation of light, in addition to the eclipses.

A newly discovered force, 200 times as effective as gravity, was announced to members of the American Astronomical Society, meeting at the Franklin Institute. Dr. Lyman Spitzer, Jr., of Harvard College Observatory, told of this attraction, which acts on minute particles of dust between the stars. It is really a consequence of a well-known effect—the same pressure of light that makes a comet tail point away from the sun. Such radiation pressure pushes on the dust particles in space. When two different pieces are in line with the body from which light is coming, the first one absorbs light that would go to the other, and hence tends to approach the second. The force of this attraction is 200 times as great as their gravitational pull on each other. With only two particles, this force would not be appreciable, but there is a great deal of material between the stars, and the attraction has to be considered in studying the behavior and distribution of interstellar matter. Each particle, he said, has a negative electrical charge of about two volts potential. Since they are charged the same way, there is a repulsion between them and thus they will never come together. Their average speed is about two or three miles per hour.

The temperature in the heart of the sun is 25,700,000 degrees Centigrade (slightly less than 50,000,000 degrees in the Fahrenheit scale) according to new calculations presented to the meeting by Drs. H. A. Bethe, of Cornell University; G. Blanch and A. N. Lowan, of New York City; and R. E. Marshak, of the University of Rochester. The density in the solar core is calculated to be about four pounds to the cubic inch, which is ten times the value for lead. Both the density and the temperature value are considerably higher than those usually taken for the sun. Dr. Bethe is known as one of the originators of the theory that the sun, and other similar stars, keep going by the energy given off in a process of transmutation of hydrogen to helium with the aid of carbon. On the basis of their present assumptions, it is estimated that this process would yield about a hundred times too much energy. However, they call attention to the fact that they have not taken into consideration the variation of the molecular weight which is caused by the progressive ionization, or breaking up of the atoms. This correction, it was said, may cause a lowering of the internal temperature. The presence of more helium, in addition to the 35 per cent. of hydrogen which they estimate in the sun, would also remove the discrepancy.

Possibility that the energy yield from U-235, form of uranium that may some day be useful as a source of atomic power, may be greater than hitherto supposed, was suggested by Dr. R. D. Present, of Purdue University. Speaking before the physicists he stated that it is theoretically possible for the nucleus of the uranium atom to divide into three parts as well as two. Such a reaction would yield about 10 per cent. more energy, according to his calculations, than splitting into two parts, or binary fission. It is the binary fission that has held the spotlight in most of the recent discussions of atomic power. It was forecast in 1939, and verified experimentally early in 1940 when minute samples of U-235 were isolated. Such fission, it has been found, can be instigated either by bombardment with slow neutrons (which are atomic fragments without electrical charge) or by gamma rays. When fission occurs, energy is released, and more neutrons are emitted. Thus, it is believed, a chain reaction could be started, since these neutrons would cause fission of additional atom nuclei. The energy given off might be utilized as a source of power, so that U-235 would be millions of times more effective than coal. So far as known, however, no one has yet isolated a large enough piece of U-235 to test this thoroughly. Ternary fission, or division into three parts, can also occur, with still larger energy yields. Though the energy to activate the process is the same as for binary fission, Dr. Present believes that with low energy neutrons, it is less likely to occur than division into two parts. So far no experimental verification of the triple division has been found.

A new trap for cosmic rays, nearly two feet in diameter, was described by Dr. Thomas H. Johnson, assistant director of the Bartol Research Foundation of the Franklin Institute, and his associates, J. G. Barry and R. P. Shutt. This is a Wilson cloud chamber, which is a cylinder containing damp air in which the pressure is alternately raised and lowered. As the expansion takes place, a line of fog will form on the trail of atomic fragments left in the wake of a cosmic ray, or of certain of the rays of radium. The cosmic rays can not be aimed at such a chamber, usually only a few inches in diameter, and it is a matter of chance when one will strike. There-

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fore, the larger the chamber, the more chance will there be of catching the rays.

Professor G. D. Birkhoff, of Harvard University, and Professor D. C. Lewis, of the University of New Hampshire, told of their newest studies on the "map problem." Surprisingly enough, experience indicates that with only four colors it is possible to make a map with any number of countries, no regions with a common boundary having the same color. However, it has not yet been proved mathematically that this is the case, though proof has been given where the number of regions is not greater than 35. Two different techniques have been used for such proofs, one the method of "chains," the other that introduced by Professor Birkhoff, and known as "chromatic polynomials." These techniques may be united to advantage. Thus, it may be that proof may be extended and perhaps even made general.

The movement of the core of the earth, which some believe to be fluid, resembles "the motion of a bowlful of jelly when you rock the bowl a little bit, but quite fast," according to David Rittenhouse Inglis, of the Johns Hopkins University. He studied the problem of whether this fluid core would be made by friction to rotate with the solid outer crust of the earth. It would, if the globe rotated about a fixed axis, he stated, but actually the axis shifts, during a period of about 26,000 years. If ordinary fluid friction alone is considered there would not be enough to pull the core around in all the earth's complicated motion. However, the core is so big that there is a considerable amount of turbulence, which increases the friction, making it nearly enough. The axis of rotation of the core is expected to lag behind the axis of rotation of the solid exterior by an angle of about one degree.

By measuring the amount of radium in mud from the bottom of the ocean, it is possible to determine how long ago that mud was deposited, according to Dr. William D. Urry, of the Geophysical Laboratory of the Carnegie Institution of Washington. Formerly samples of the mud were merely scooped up in buckets, but in recent years a method devised by Dr. Charles S. Piggot, Dr. Urry's colleague, has given specimens down to a depth of a number of feet below the bottom. This device consists of a long tube, which is shot into the mud. The radium is nearly all in the top layer of the muds and clays. This is explained because the uranium, the "grandfather element" which disintegrates into ionium and then into radium, remains dissolved. The radium formed drains down to the bottom. Then it disintegrates, half the atoms committing suicide in 1700 years, half of what remains in another 1700 years, etc., until after many thousands of years, practically all the radium is gone. Thus, by measuring the amount of radium, it is possible to tell when that particular part was deposited. In really deep parts of the ocean, even ten feet of the bottom may take as long as a million years to build up. This is only a small part of the recent life of our planet but an interesting part, because in it the earth has seen the ocean rise and fall, great changes of climate, ice fields stretching down into New Jersey and receding back into Canada, and, even now, perhaps only temporarily, retracted to the polar regions. All these and many other changes have left their very definite marks in the character of the bottom of the ocean.

No place in the world, not even the bottom of the ocean, is safe from the prying eye of the candid camera and its accompanying flash bulb. A new kind of deep-sea photography, of use in fisheries management, was described before a meeting of the Limnological Society of America by Professor George L. Clarke, of Harvard University and the Woods Hole Oceanographic Institute. Professor Clarke told of the biological application of apparatus invented by Dr. W. Maurice Ewing, of Lehigh University, for purpose of geographical research. Dr. Ewing's deep-sea flash-bulb camera can be lowered to a position near the bottom, where it gets a snapshot of an area about 2½ by 3½ feet in size. It has worked successfully in waters from about 125 feet to more than half a mile deep. Photographs taken in the waters of Georges Bank, the fishing ground northeast of New England, show a dense bottom population of animals. There are crabs, a sea-snail, starfish, sea-urchins, sand-dollars, deep-sea scallops and other shellfish, tube-building worms, and sponges. In two of the photographs the sand-dollars are so numerous that they are actually piled on top of each other. Singularly enough, however, no sign of plant life could be found on any of the photographs.

Dr. C. Hawley Cartwright, now of the Corning Glass Works; John Daniel, of the U. S. Bureau of Public Health, and Alex Petrauskas, have measured the transmission of infrared rays through the cheek to the inside of the mouth. Visible light of shorter wave length, from the violet to the orange part of the spectrum, is stopped completely. The transmission begins with orange light and increases up to the longest visible red waves, where about 2 per cent. is able to penetrate. These have a length of about 7,000 angstroms (about one thirty-five-thousandth of an inch). For waves still longer, between 10,000 and 13,500 angstroms, there is more transmission, with a maximum of 3 per cent. at 11,000 (one twenty-four-thousandth of an inch). These infrared rays are the same as heat rays. It was found that by applying them from a tungsten lamp with a water filter it was possible to raise the temperature inside the mouth 3 degrees Fahrenheit without discomfort.

A change in only eight or nine molecules of the visual purple, in the retina of the human eye is sufficient to produce the sensation of sight, according to Professor Selig Hecht of Columbia University. Associated with Professor Hecht in his experiments were Simon Shlaer, also of Columbia, and Dr. Maurice H. Pirenne of the Belgian-American Educational Foundation. In the research, an observer would stay in a dark room for half an hour, until his eyes had become dark-adapted and reached a maximum of sensitivity to light. Then a flash of light, exactly a hundredth of a second in duration and of carefully measured radiant-energy content, was shot at his eyes. The amount of light actually reaching the retina, when the minimum sight-causing illumination was reached,

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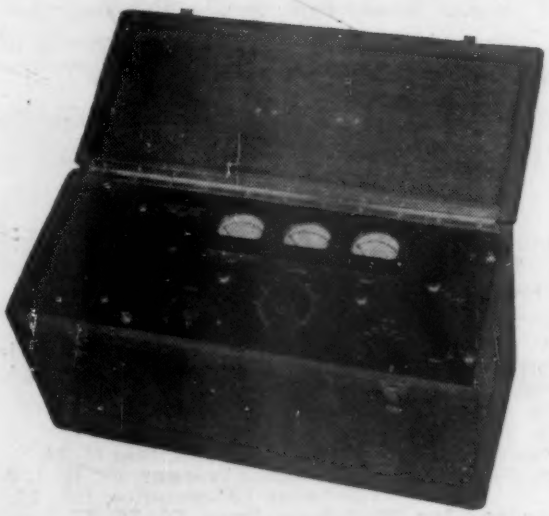

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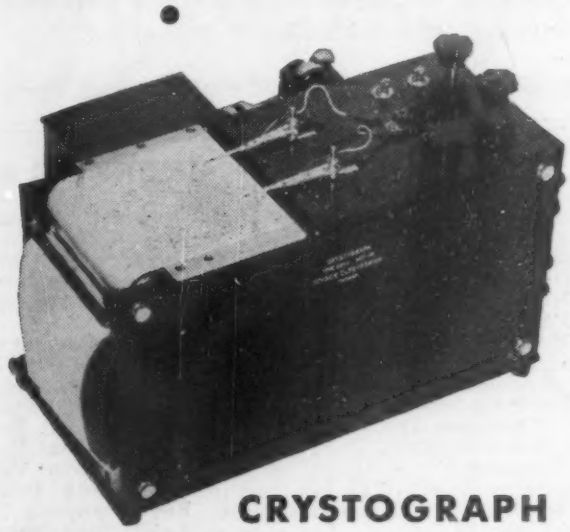

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was calculated at eight or nine quanta, each quantum being able to cause the necessary chemical change in one molecule of visual purple in the retina. Professor Hecht pointed out that "judging by the structure of the retina, the structure of light, and the chemistry of visual purple, it is hard to conceive of a biological system which could be more sensitive than this. Certainly there are no physical systems which even approach it."

Better use of the sulfa drugs in treating pneumonia and human ailments may come from laboratory studies was reported to us by Dr. George W. Raiziss, of the Graduate School of Medicine of the University of Pennsylvania, and Dr. M. Severac and J. C. Moetsch, of the Dermatological Research Laboratories of the Abbott Laboratories. Sulfapyridine is a better weapon against the pneumonia germ than sulfathiazole, although the latter is less toxic. Sulfathiazole, on the other hand, gives better results in treating infection with the staphylococcus aureus, the germ commonly thought of as the cause of boils and which also causes a serious form of blood poisoning. The effect of the two sulfa drugs in Type II and Type III pneumonia infections in mice was almost equal in the first 48 hours. After 28 days, however, 28 per cent. of the mice infected with Type II pneumonia and treated with sulfapyridine survived, compared to only 3 per cent. survival of mice treated with sulfathiazole. Of the mice infected with Type III pneumonia germs, 12 per cent. survived following sulfapyridine treatment, but only 3 per cent. survived with sulfathiazole treatment.

Dr. Harvey C. Rentschler, director of research for the Westinghouse Lamp Laboratories, reported that germs inherit strong or weak constitutions from their ancestors, and the strength of a germ varies according to the stage of its life cycle. During a germ's weakest moment it is eight to ten times less strong than during its most healthy period of life. This variation is considerably greater than was suspected and must be seriously considered in making tests of the efficiency of germ-killing agents. Studies of the germ-killing action of ultraviolet rays led to Dr. Rentschler's discoveries about the strength and weakness of bacteria and also shed new light on how radiation affects bacteria. Contrary to the generally accepted "single photon hit" theory, according to which bacteria are either killed or escape unscathed when subjected to lethal radiation, Dr. Rentschler found that bacteria may be injured, if not killed outright, by sublethal doses.

Dr. True W. Robinson, of the University of Illinois, reported that one of the substances that promotes growth of roots in plants was found to be effective in checking growth of one type of cancer in mice. He soaked pieces of mouse sarcoma tissue in a solution of indole-3 acetic acid, and then transplanted them into the bodies of mice. In eighteen experiments, only one piece "took," while in parallel control experiments with similar tissue not given the preliminary soaking, all 18 sarcomas grew. In other experiments, Dr. Robinson tried the effects of injecting the indole-3 acetic acid into the mice themselves, both before and after they had received implants of sarcoma tissue. These experiments also indicated that the acid has an inhibitory effect on the growth of the sarcoma.

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ATOMIC PHYSICS AND BIG TELESCOPES

BY furnishing an explanation of how stars are fueled, atomic physics has been responsible for one of the greatest advances in astronomy during the past decade. Big telescopes are not the only means by which the science advances, was stated by Dr. Harlow Shapley, director of the Harvard College Observatory, in a lecture given under the auspices of Sigma Xi, at St. Louis.

He credited Dr. Hans Bethe and his colleagues at Cornell University with the proposal of a plausible method by which, it can be presumed, the stars turn the matter of which they are made into energy, and broadcast it into space.

"It has long been a serious problem," he stated, "to explain why the sun exists at present, and why it radiates at apparently the same rate as it did in Paleozoic times. The ancient plants and animals apparently lived under conditions similar to our own—two hundred million years ago.

"We have long known that if the machinery for transforming matter at the appropriate rate, and at the temperatures existing in the stars, could be found, we could account for the energy source of radiation. The deuterium process, which burns the ever-present hydrogen into helium ash by way of heavy hydrogen; and the carbon stove mechanism, by which the hydrogen goes into the helium ash by way of the transformation of carbon atoms—these two mechanisms appear to be the chief agents in supplying energy for running the universe."

However, the problem is not yet fully solved.

"A great advance has been made," he continued, "but some problems are left over. Where, for example, did the hydrogen come from?" He did not give the answer.

To explain astronomical puzzles of the star clouds, systematic star motions and the bunching of peculiar types of stars and of stellar systems, Dr. Shapley suggested that there is, even in the vicinity of the sun, some controlling "arm structure." This also seems to be manifested in the dominance of a spiral shape in other galaxies, or milky systems. Perhaps our milky way has such spiral arms.

"Progress toward unraveling the mysteries of the structure of our galaxy is made through studies of star colors, star counts, the distribution of obscuring matter, the spectral classification of faint stars and, indirectly, through the distribution of the external galaxies. Their presence or absence in a field of stars is a rough measure of the amount of absorbing material. Such material, if present, may affect measures of star colors, distances and numbers.

"Something like half a million external galactic systems have now been photographed in the Harvard survey of that part of the universe within reach of the large telescopes. Most of them are more distant than twenty million light years and nearer than two hundred million light years. The detailed studies of the distribution of external galaxies is leading slowly to knowledge of the general 'metagalactic structure,' and bears therefore upon the problems of the expanding universe, age of the stellar systems and the theory of relativity as it applies to the structure of the universe."

BOTANICAL DRUGS

THE only drugs of which supplies in this country may run short if war in Europe is prolonged are those drugs obtained from certain plants, according to the report of Dr. S. De Witt Clough, president of the Abbott Laboratories, in the current issue of *War Medicine*, the new medical journal published by the American Medical Association in Chicago. The first issue was mailed to physicians and others interested on January 28.

Of vitamins, including cod-liver oil, vaccines and other biologics, hormone remedies such as insulin for diabetes, sulfanilamide and the other sulfa remedies, anesthetics of all types, antiseptics, disinfectants, bandages and surgical dressings, the United States has plentiful supplies. "The drug industry," he says, "is in a much better position to supply the medical profession, hospitals, the Red Cross, the War Department and governmental agencies with pharmaceuticals and medicinal chemicals than it was during the World War.

"There is already a growing scarcity of such items as belladonna root and hyoscyamus, a source of scopolamine," Mr. Clough reports. "While these botanicals have been coming from foreign countries, it is reasonable to believe that sufficient supplies of belladonna can be cultivated in this country to take care of civilian and military requirements.

"This was the case in the World War, when not only belladonna but digitalis and other medicinal plants were grown in Washington, Oregon, California, Minnesota, Michigan, Indiana, New Jersey, Pennsylvania, Virginia and Florida. Digitalis of excellent quality is still grown in the United States but not in sufficient quantity, as yet, to supply domestic, export and military needs. It is hoped that domestic cultivation will be increased.

"Atropine sulfate can be obtained from jimson weed, which can be grown on almost any farm land. It may also come about that the alkaloid, atropine sulfate, can be synthesized. When the World War was over, the cultivation of belladonna and some other medicinal plants was practically abandoned in the United States, owing to the lower cost of labor in other countries."

Mr. Clough urges that agricultural departments of state universities and colleges grow such medicinal plants in this country as are adapted to the soil and climate of the various states and experiment with others not yet cultivated in this country. He states that we are in excellent condition to produce large quantities of biologic items such as vaccines and antitoxins; that we could take care of a large part of the world requirements for bandages and dressings; that we are in "an advantageous position" to produce enough vitamin oils to take care of the entire Western Hemisphere; and that we lead the world in

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ELECTRICAL SHOCK

AFTER a person has repeatedly been subjected to electrical shock, he tends to develop immunity, was reported at the Philadelphia meeting of the American Institute of Electrical Engineers, by Professor Charles F. Dalziel, of the College of Engineering of the University of California; Dr. John B. Lagen, of the School of Medicine, and Joe L. Thurston, a senior electrical engineering student.

The immunity is not enough, however, to permit a person to reach the stage where he could sit in comfort in an electric chair. Part of the ability to withstand increasing shock, it was suggested, is due to a psychological factor, as the subject gets used to it.

Measurements were made on 120 men in order to find the greatest current at which the subject could let go of the electrode carrying the current. The voltages ranged from 20 to 75 and the current, which is measured in amperes, was increased to the point where the person tested could no longer release his grip. One subject was able to let go at about a fiftieth of an ampere, but the mean value was about three quarters as much. The experiments did not use heavy enough currents to cause unconsciousness.

The effects on the subjects were described as follows:

"If the electrodes are held in the hands, the threshold of perception is about one thousandth of an ampere. As the current is gradually increased, the sensation of tingling in the fingers, hands and wrists is intensified. At the same time the muscles of the fingers and hands, and later also of the arms, tighten involuntarily. At the higher currents (6–8 thousandths of an ampere and above) the discomfort from severe muscle contraction is more evident than the sensation of tingling, and may even be painful.

"For currents of this magnitude the individual may still be able to release his grip of the electrode by a determined muscular effort. As the current increases, the involvement reaches the shoulder girdle and extends to the external muscles of the chest so that respiration becomes somewhat difficult. The higher currents cause a sensation of mental discomfort which may even amount to a nameless fear, although the individual knows that at any indication from him, such as a nod or a cry, the current would be shut off."

PAPERS READ AT THE PHILADELPHIA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

(*Continued from issue of February 7, p. 46*)

Alcoholic mental disorders cost $178,191,272 to the people of the United States each year, according to an estimate made by Dr. Horatio M. Pollock, director of mental hygiene statistics, New York State Department of Mental Hygiene. Patients suffering from alcoholic mental disease or alcoholism in mental hospitals throughout the United States number about 31,220. Since the cost of maintaining these patients averages about $500 a year, the total cost would be $15,610,000. To this sum must be added the economic loss which results when a man or a woman suffers mental breakdown. Figured only for those patients first entering a mental hospital during a single year, this would amount to $86,154,712. But this sum does not include the loss of earnings and the money spent on alcohol during all the years of alcoholic excesses that went before the victims finally landed in the mental hospital. This amount is estimated to be about $76,426,560. These three amounts make up the striking total of $178,191,272, which does not count losses due to physical illness, crime connected with intoxication, pay of policemen or cost of courts and jails.

A theory that anesthesia consists in the "jelling" of protoplasm was offered before a symposium on protoplasmic streaming by Professor William Seifriz, of the University of Pennsylvania. He has devoted a quarter-century of research to the properties of protoplasm, principally as evinced in the lowly organisms known as slime-molds, whose bodies consist merely of blobs of naked protoplasm. Treating these primitive forms of life with various anesthetics, he found that the streaming movement that goes on almost incessantly in its protoplasm stopped for some of the drugs, but apparently was immune to the effects of others. In every case where the streaming stopped the protoplasm had set into a jelly-like consistency, instead of the viscous fluid which is its usual state. "The gelatinization of protoplasm reduces all physiological activities, including irritability, to a minimum, and this is anesthesia."

Very high pressure, such as is found in the deepest parts of the sea, has a paralyzing effect on protoplasm, was reported by Professor Douglas A. Marsland, of New York University. The pressure apparatus with which he worked was rebuilt out of a hydraulic jack such as is used in commercial garages for lifting heavy trucks. The effect of extreme pressure is most evident in stopping the streaming movement that is characteristic of all protoplasm. This streaming can be observed readily in the leaf cells of certain plants, in moving amoeboid cells, in dividing animal cells, and in the expansion and contraction of the color bodies in the skins of fishes. All these varied forms of protoplasmic streaming were retarded as the pressure went up, and stopped altogether at the same high pressure—5,000 pounds per square inch. The stopping occurred when non-streaming parts of the protoplasm became unable to change from fluid to a firmer, jelly-like substance, which appears to be a necessary prelude to the streaming activity.

Colchicine, the drug that produces giant plants and causes great speed-up in evolutionary changes, has been used successfully for the first time in producing apparently similar changes in animals by Dr. Edna Higgins,

of the University of Pittsburgh. Earlier experiments with colchicine on animals have uniformly resulted in the early death of the animals, when the drug was used in sufficient concentration to obtain any results at all. However, by injecting very small amounts of highly dilute colchicine solutions into the eggs of chickens at various stages of incubation, Dr. Higgins has succeeded in obtaining six healthy birds that have survived to maturity. In one group of four chickens, injected after seventy-two hours of incubation, now seventeen months old, the combs and wattles of both males and females are twice the normal size, and the males also have two abnormally long tail-feathers apiece. Two others, out of a group injected during the thirteenth day of incubation, show less effect. Further work is now being conducted to determine whether colchicine produced the effects directly, or whether it worked through the sex glands.

Manganese is needed by oysters no less than by higher animals if they are to function as mothers, Dr. Paul S. Galtsoff of the U. S. Fish and Wildlife Service reported to the zoologists. He found a marked rise in the amount of manganese present in oysters when their eggs were developing and ripening. This manganese content, moreover, was concentrated principally in the ovaries. Concentration was relatively low in other tissues, as it was also in the reproductive organs of oysters in the male phase of their existence.

Dr. Gregory Thoennes of St. Mary's College of Winona, Minn., suggested that seventeen-year cicadas, usually called "locusts" when their shrilling swarms appears, may do more harm to trees than is commonly supposed. Dr. Thoennes has kept track of trees affected by an outbreak of seventeen-year cicadas in Missouri six years ago, and is of the opinion that the consequences of the excessive egg-deposition in the rind of young twigs are being too lightly dismissed by bioloigsts. Dr. Thoennes stated that in the case of orchard trees especially, measurements made for the past six years indicate a marked decrease in the yearly growth of injured branches. This change in growth rate is more noticeable in older trees than in younger ones, and in neglected trees than in those that have been well cultivated. In either case, however, the growth of affected branches is less than that of uninjured ones.

An extract of last year's dead leaves will delay the opening of next year's buds, on cut fruit-tree twigs set in it, was reported by Professor C. G. Vinson, of the University of Missouri. A contrary effect on peach twigs, forcing the flowering at an earlier date, was obtained with several organic acids commonly found in plant tissues—succinic, maleic, fumaric and malic. Tannic acid had an effect similar to that of the dead-leaf extract, hindering flower opening. The experiments reported by Professor Vinson are preliminary steps in a search for a compound that can be sprayed on dormant fruit trees in early spring, to prevent them from blossoming too early and then getting caught by frost, at present a source of great losses in northern orchard regions.

Cotton yields were increased by a third in experimental plots sprayed daily for three weeks during July with a one-to-one-million solution of the growth-promoting chemical, indole acetic acid, according to a report presented by Professor J. C. Ireland of Oklahoma Agricultural and Mechanical College. This would suggest that the use of a synthetic hormone causes the cotton plants to develop more bolls to maturity. There is an apparent increased vigor of the plants, probably due to an increased rate of the use of plant foods. In another experiment, performed on individual plants in the greenhouse, the pistil, or seed-bearing part of the flower, was treated with a paste containing colchicine and indole acetic acid. Unpollinated pistils produced fertile seed, which thus had a mother but no father. Plants are now being grown from those seeds. The cotton fiber from the colchicine-treated flowers was longer and stronger than that from untreated flowers.

To break up the inconvenient habit certain apple trees have of producing huge crops one year and practically none the next, is a possible outcome of experiments reported by J. R. Magness and L. P. Batjer of the U. S. Department of Agriculture. They succeeded in breaking the rhythm of bearing in some of these "two-year" apple trees simply by spraying the buds, just as they began to show pink, with caustic chemicals that killed the flowers. The following season, when ordinarily the trees would have borne little or no fruit, they produced plenty of apples. The happy mean, a method whereby only part of the superfluous buds can be killed and equal crops produced every year, is still being sought.

ITEMS

THE closest imitation made thus far in the laboratory of the strange green light of the northern lights has been obtained by Dr. Joseph Kaplan, of the University of California at Los Angeles. This was done in a tube to which oxygen and nitrogen were admitted, and an electrical discharge passed through. A shutter covers the tube while the discharge takes place, but uncovers it afterwards, to expose the afterglow which persists for several seconds. In such a manner he has obtained, by itself, the green light of the aurora. This is a so-called "forbidden" radiation, that is, it can not be reproduced with the usual laboratory behavior of these gases. "A perfect reproduction of the auroral spectrum should now be possible. Strangely enough, one has to go to high pressures in the laboratory to reproduce low pressure auroral phenomena; the higher the pressure, the better the reproduction."

FISH in the sea, no less than fish in rivers, are governed in their movements to a considerable extent by water currents, states Dr. Harald U. Sverdrup, director of the Scripps Institution of Oceanography at La Jolla. Upwelling currents, that bring water rich in marine food from the depths to the surface, are an especially important factor in determining the places where fish congregate to feed. There are strong upwelling currents along most of the California coast, which account to a considerable extent for the wealth of West Coast sardine and other fisheries.

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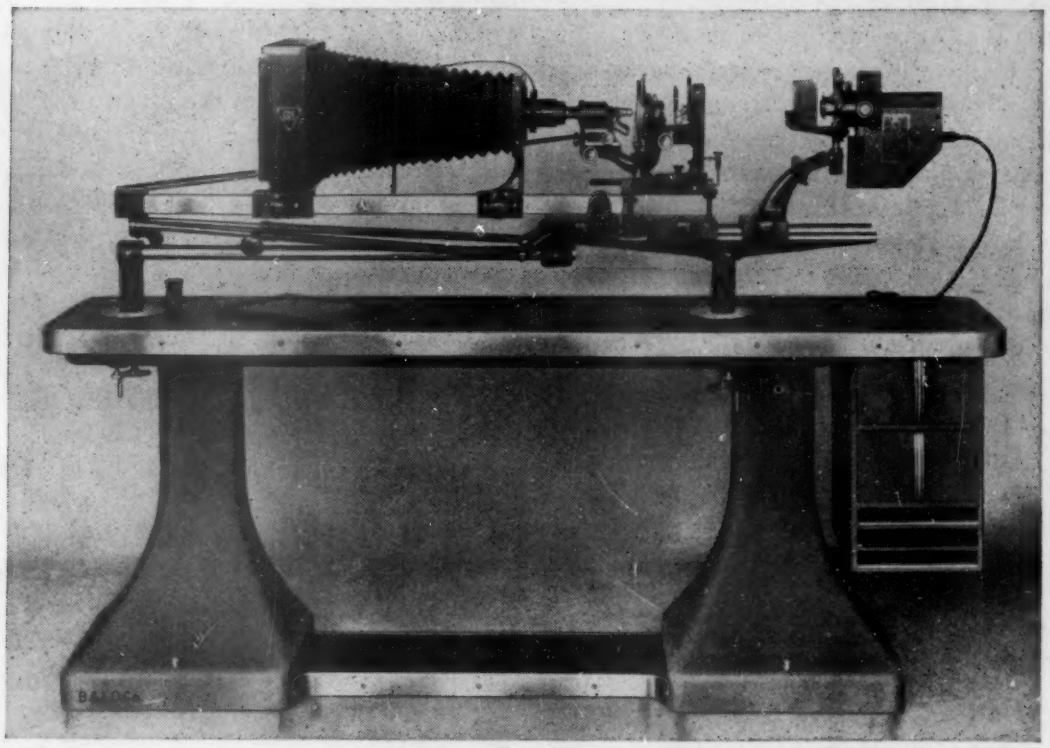

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SCIENCE NEWS

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THE EARTH'S MAGNETISM

SPEAKING at Philadelphia at a two-day meeting of the American Philosophical Society commemorating the centenary of the first American magnetic observatory, established by Alexander Dallas Bache, Dr. J. H. Dellinger, chief of the Radio Section of the National Bureau of Standards, told of ways in which the earth's magnetism affects wireless transmission.

"It has long been known," he stated, "that radio transmission on the high radio frequencies is markedly poorer between North America and Europe than over other transmission paths. A possible relation of the radio anomaly to the propinquity of the magnetic pole was suspected, but there were no data on which to base a positive conclusion. Following a discovery that this disparity existed at the broadcast frequencies also, a systematic study was begun in 1935 and is still in progress. Measurements have been made in Europe and in North and South America of the received intensities of broadcast stations in the other continents, each (northern) winter since 1935."

Disturbances in the ionosphere, the complicated layer more than fifty miles high from which radio waves are reflected back to earth, are associated with the magnetic storms at lower levels. These, Dr. Dellinger stated, "increase the variability of radio transmission between North America and Europe much more than between South America and either North America or Europe. The ionospheric and magnetic storminess, moreover, is prevalent much more of the time in the more northerly regions traversed by the radio waves between North America and Europe. Thus this transmission path is far more subject to the disturbing effects than the paths more remote from the polar regions."

Magnetic disturbances on the earth are closely connected with the activity of the sun. In addition to the effect of the general magnetic storminess, there is another. Dr. Dellinger described this as "a very sudden, relatively brief perturbation occurring simultaneously throughout the day hemisphere, the effect being a maximum at the subpolar point and a minimum in the polar regions; it is directly caused by a solar eruption."

Dr. L. V. Berkner, of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, explained how the various layers of the ionosphere are measured by sending up radio waves and catching their echoes. There are three main layers, namely: the E-layer, 62 miles high; the F-1 layer at 140 miles and the F-2 layer at 220 miles. At night, or when the sun is low, the last two merge to form a single F-layer at a level of 155 miles. Apparently corpuscles shot out from the sun disturb the F-layers in which, he stated, occur the chief ionospheric effects associated with magnetic storms.

A NEW HIGH VOLTAGE POWER LINE

DEFENSE construction in and around Chicago will be less likely to suffer from electric failure on account of a new high voltage power line just completed. Details of the line, which is 147 miles long, and brings more than 200,000 horsepower of electrical energy from coal fields in southern Illinois, were given at the Philadelphia meeting of the American Institute of Electrical Engineers by M. S. Oldacre and F. O. Wollaston, of the Commonwealth Edison Company.

Special consideration, they reported, was given in designing and building this line to obtain reliable service and eliminate outages caused by the two worst enemies of transmission lines—sleet and lightning—both of which are quite prevalent and severe along this route. As a result of study by engineers connected with the operation of existing transmission lines and also those of the electrical manufacturing companies, it is believed that the solution of these two major troubles of transmission lines has been obtained.

It has been found that when wind of sufficient force strikes sleet-covered wires, the wires will be lifted momentarily in the same way as a kite or airplane, and the alternate rising and falling and the swinging of the wires causes them to appear to "gallop" and sometimes come in contact with one another. This will at least interrupt power service over the line if it does not cause actual burning or breaking apart of the wires. Common practice on important smaller lines is to put extra electric current through the sleet-covered wires to melt the sleet away before it becomes dangerous. The wire or cable required for this line was so large—one and one sixth inches in diameter—that it could not be heated sufficiently. Instead, extra-strong supports were provided and the wires placed farther apart than usual so that there is no chance of the wires "galloping" or swinging together.

The elimination of lightning troubles on existing transmission lines has been obtained by using sufficient insulators for the electric wires and by placing additional wires above the electric power wires to intercept the lightning currents and direct them into the earth over paths of very low resistance. On this new line the latest type of high-strength insulators, nearly ten feet long, have been used and the intercepting wires, known as "ground" wires, have been installed so that there is practically no chance of a lightning flash to the electric wires.

At the same meeting, two other Commonwealth Edison Company engineers, H. E. Wulfing and T. G. Le Clair, told of some of the operating details of the new line. Though carrying 220,000 volts it is so arranged that, should a short circuit occur anywhere on the line or its terminals, the switches at both ends will open automatically and disconnect the line in one sixth of a second. One interesting feature in the operation of the line is the use of radio waves on the transmission wires to perform many essential functions. Radio as used in this manner is known as carrier current and differs from space radio, commonly used in broadcasting, in that it is con-

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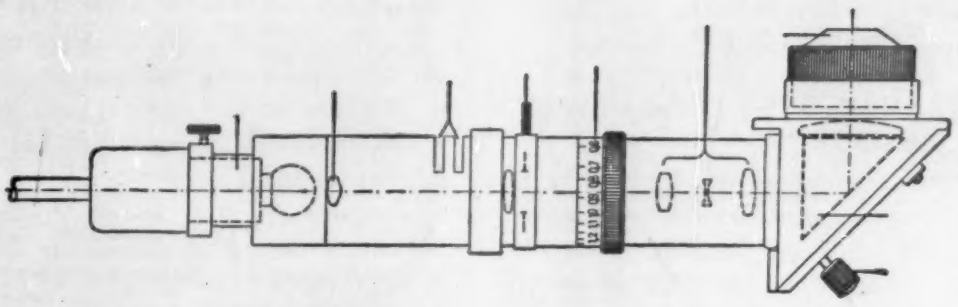

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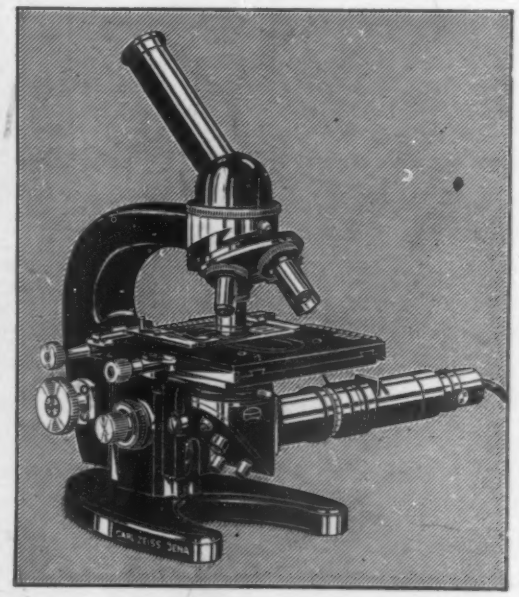

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NATIONAL DEFENSE USES OF NATURAL RESOURCES

DR. IRA N. GABRIELSON, chief of the U. S. Fish and Wildlife Service, at the opening session of the Sixth North American Wildlife Conference at Memphis, pointed out that national defense uses of irreplaceable natural resources must be guided by discretion, lest harm rather than good result.

Our very zeal for strengthening America can lead us into errors that have an exactly opposite effect, pointing out as past examples the ill effects of over-fishing of our waters and over-cutting of our timber lands during the emergency of 1917–18. The country is still suffering the consequences of the mistakes made by honest but over-enthusiastic patriots in those tumultuous days.

Even worse may be done to us by cold-bloodedly selfish persons who place self-interest ahead of patriotism, and advance the plea of defense promotion only as a Trojan horse for selfish schemes of their own. Watch out for such things as efforts to cut priceless virgin timber out of national park areas, under the excuse that it is to be used for "defense." Dr. Gabrielson pointed out that "If this country is to continue to be a good place to live in, or to be one worth fighting for, we must use intelligently the resources of soil and water, and the products of soil and water, not only in good times but in bad times, and in national emergencies as well as in normal times."

In the course of his address, Dr. Gabrielson reviewed the progress of the wildlife restoration program during the past five years. Land acquisition and refuge creation have gone forward very well though much still remains to be done. The same is true in the arrangements for cooperation with state anl local agencies, especially in basic ecological research. Costs of these programs are defrayed mainly by persons and groups most interested, through sale of "duck stamps" and sales taxes on sporting arms and ammunition.

Somewhat slower progress, though still fairly satisfactory, was noted by the speaker in such fields as educating the public in the recognition of wildlife values, and in the promotion of specific research programs where present knowledge is weakest, especially in the study of the ecology of water areas. Much more needs to be done, too, toward the restoration of fish and of fur-bearing animals. Both of these were once among America's greatest natural resources, and intelligent action can do much to restore them to a large degree of their former importance.

By far the least satisfactory situation, Dr. Gabrielson said, exists with regard to river and lake pollution. Good progress in the setting up of municipal sewage disposal plants during the past few years is contrasted with virtually no progress at all in getting rid of pollution due to industrial wastes. Most industrialists, the speaker said, have proved stubbornly uncooperative, and he challenged sharply the right of any man to misuse publicly owned waters as his private sewers.—FRANK THONE.

SULFANILAMIDE AND RHEUMATIC FEVER

INCREASED hope that sulfanilamide may prove the means of preventing attacks of rheumatic fever appears in a report to the current issue of the *Journal* of the American Medical Association and in editorial comment on that report.

A record of no attack of rheumatic fever among 55 patients while taking continuous sulfanilamide treatment from November through June of each year between 1936 and 1940 is announced by Dr. Caroline Bedell Thomas, Dr. Richard France and Dr. Franjo Reichsman, of the Johns Hopkins Hospital and University. During the same four years, fifteen major attacks of acute rheumatic fever occurred among 150 patients not taking sulfanilamide during the control period.

Rheumatic fever is a wide-spread disease which seriously damages the heart and leads frequently to early death. More than 900,000 persons in the United States are said to suffer from rheumatic heart disease. It is the chief cause of death among school children and is responsible for at least 30,000 deaths annually in the United States.

The exact cause of rheumatic fever has not been discovered. Infection with the beta hemolytic streptococcus usually precedes attacks and this germ is thought to play a significant rôle in starting the disease. This germ is the one over which sulfanilamide accomplished its earliest triumphs, saving mothers whose lives were threatened by this streptococcus during childbirth.

Because of these facts, sulfanilamide was tried as a treatment for patients suffering attacks of rheumatic fever. It was not successful in these cases and there was some evidence that it might be dangerous. The Baltimore doctors, however, and Dr. A. F. Coburn and Dr. Lucile V. Moore, of New York City, decided to try it, not as treatment, but as a preventive of recurring attacks of the disease. Authorities generally agree that the patient who survives his first attack of rheumatic fever would have a good chance of living out a normal life span if he could be protected from these repeat attacks with their added injury to the heart.

As early as 1939, doctors reported in Baltimore and New York that major attacks of rheumatic fever did not occur, or occurred in only one per cent. of patients given sulfanilamide prophylaxis during the winter and spring months when streptococcus infections are most numerous. The present report of experience over four years adds to the hope that sulfanilamide prophylaxis of rheumatic fever will prove successful.

The drug is given twice daily in doses smaller than those used for treatment of disease. No serious toxic effects were observed. The editor of the *Journal* of the American Medical Association comments on the "hopeful picture" the report gives and adds: "The final evaluation

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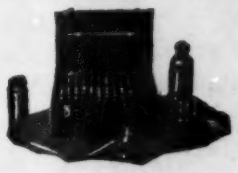

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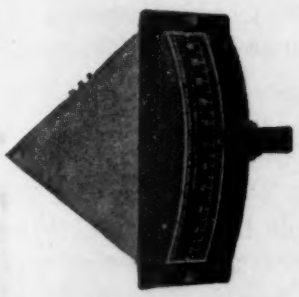

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of this method of prevention awaits results obtained in large, carefully controlled series of young rheumatic subjects. In view of the wide-spread occurrence and the crippling effects of rheumatic fever, it is to be hoped that interest in and support for such projects will be sufficient to permit a final evaluation of this promising lead in the prevention of rheumatic fever.''

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SQUEEZING and shaking substances valuable in medicine out of cultures of disease germs by means of intense sound waves is the biological feat that has been accomplished by Dr. Leslie A. Chambers and Dr. Earl W. Flosdorf, of the University of Pennsylvania.

The substances they obtain belong to the class known as antigens. They are poisons secreted within the germs' bodies. Injected into the human body in suitably small quantities, they may be used in provoking the formation, by our own tissues, of opposing substances known as antibodies, which defeat the germs if they attack later on. Or the antigens may be injected into the bodies of animals, from which blood is later withdrawn for making immune serums for medical use.

Present methods of obtaining antigens involve heating, addition of chemicals, or other treatments that injure or destroy certain of the more sensitively composed antigens. This is what the new method of Drs. Chambers and Flosdorf is designed to avoid. Its treatment of the germs is strictly physical or mechanical, and it can be conducted at a low temperature.

The foundation of their apparatus is a magnetized metal tube, usually made of nickel, which is caused to vibrate extremely rapidly by flowing an alternating electrical current around it in coils. The sound waves thus set up may be either exceedingly shrill, or even so high-pitched as to be in the ultrasonic range, beyond reach of the human ear. In either case, they are made highly intense.

Over the upper end of the metal tube a glass tube is fitted, with a leak-tight rubber joint. Into the chamber thus formed a culture fluid containing billions of germs is poured. Then the current is turned on and the vibrations started. After the treatment has been continued long enough to get out most of the antigens (and incidentally, to shatter most of the germs), the process is stopped, and the liquid is first centrifuged and then passed through a fine porcelain filter, to remove all débris and any of the germs that may have survived the treatment.

The antigens are in the clear, germ-free liquid that has passed through the filters. Some types of these antigens are so sensitive and unstable that they will spoil if kept for only a couple of hours at temperatures a little above freezing. However, if the liquid is frozen at once and the water evaporated out of the ice, the solid, dried residue, now consisting of concentrated antigens, can be kept for a year or more.

Drs. Chambers and Flosdorf have obtained U. S. patent (No. 2,230,997) on their apparatus and process, on which they have assigned their rights to the University of Pennsylvania.

ITEMS

FISH in hatcheries, no less than infants in nurseries and grown-ups at table, need a certain amount of bulk and roughage in their food. Experiments at Cornell University have demonstrated the virtues of what is perhaps the purest form of roughage known, for it must be completely indigestible. Cellophane, cut into fine shreds, is fed to the fish along with their other food. They eat it readily, and seem to thrive on it.

HUNGARIANS are now eating ersatz meat, concocted cheaply from "twelve garden plants and vegetables," and Germany may borrow the idea for large-scale production, according to the *Foreign Commerce Weekly*. Put up as a powder, the meat invention is made edible by adding water, salt and bread, and can be cooked in hamburger or sausage-cake style by adding butter, cream and spices. About 2.2 pounds of artificial meat are said to contain 3,727 calories, and to consist of 40 per cent. carbohydrate and 22.3 per cent. white albumen. The cost of four portions is said to be less than 20 cents.

WRAPPING oranges and other citrus fruits in paper treated with diphenyl, a method originated by Dr. Adalbert Farkas, of the Hebrew University, Jerusalem, has been used with marked success by citrus growers in New South Wales. Losses of fruit in the treated wrappers were from two thirds to three fourths less than losses in control lots of similar fruit kept in ordinary untreated wrappers. Dr. Farkas was fromerly a member of the faculties of the Technical College in Vienna and the University of Frankfurt-am-Main. After leaving Germany, he was for a time at the University of Cambridge, England.

THAT starch may soon be made commercially from kafir, a grain-yielding sorghum, is indicated by research work by J. W. Greene, assistant professor of chemical engineering at Kansas State College. It may be possible to start this new industry within a few months if proper progress is made. The fact that kafir possesses starch as a component part has been known for years, but chemists have had difficulty separating it from the rest of the grain on a profitable scale for commercial use. Professor Greene and his research assistants have been interested mainly in processing the starch and finding new uses and commercial application. Professor H. N. Barham, of the department of chemistry, has been studying the properties of the starch.

THOUGH chemically the same as plaster of Paris, a new gypsum plaster, described at the meeting of the American Institute of Chemical Engineers, is about twice as strong as the old-fashioned article. In fact, it approaches Portland cement in strength. The new product was announced by E. P. Schoch and William A. Cunningham, of the University of Texas. It is prepared by heating gypsum in a magnesium sulfate solution, whereas plaster of Paris and ordinary wall plaster are made by the dry calcination or burning of gypsum. Experiments in a small pilot plant indicate, they stated, that it can be made at a cost of $8.82 per ton, a figure that may be reduced by large-scale production. Probably the magnesium sulfate plaster will find its chief application in wall board, tile and other factory cast products.

ESTIMATION OF SULFUR IN VEGETABLES

REAGENT—p-Aminodimethylaniline

METHOD—Colorimetric

REFERENCE—Diemair and Koch, *Z. anal. Chem.*, *119*, 94 (1940)

THE LOOSELY BOUND SULFUR present in plants reacts with p-aminodimethylaniline in hydrochloric acid solution, to form methylene blue. The density of the color obtained is estimated in a Pulfrich photometer. The combined sulfur in the tissue does not react under the conditions of the test.

Eastman P 2147 p-Aminodimethylaniline is of a purity suitable for this determination; it is priced at $.70 for 10 grams. An abstract of the article in which the procedure is described will be forwarded promptly upon request. Eastman Kodak Company, *Chemical Sales Division*, Rochester, N. Y.

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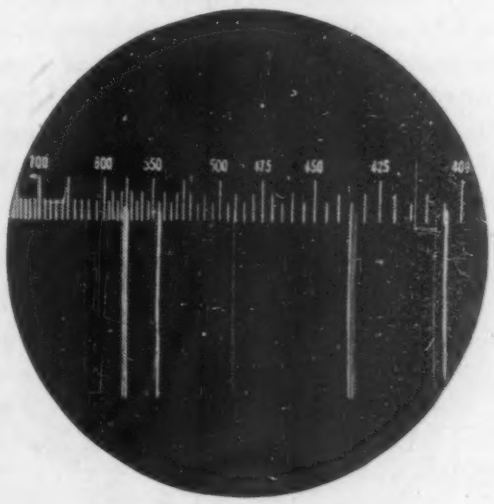

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SCIENCE NEWS

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TRAINING IN SCIENTIFIC THEORY

STRENGTH in theory as well as practice is vitally necessary for America and the democracies if they are to make full use of science, according to Dr. Marston Morse, president of the American Mathematical Society and chairman of the War Preparedness Committee of that society and the Mathematical Association of America. Speaking before the National Council of Teachers of Mathematics, he cited problems in nutrition, disease control, hours of labor, public morale, problems in planting, breeding and war substitutes, mathematical and mechanical problems in ballistics, airplane design and air defense as awaiting solution.

He said: "We must be strong in theory as well as practice. Not every emergency will be anticipated. America is strong in the extremes of science—in pure science and in its final applications. Because of our wealth we have relied heavily upon experiment, but experimentation takes time, and now we have not time. We should immediately seek a closer alliance of theory and practice. Mathematics is a principal instrument in this union. Teachers of mathematics should present to their pupils technological and industrial applications whenever possible. This can and should be done without abandoning the concept of mathematics as a general tool. We have noted with regret that aeronautical schools are lowering their entrance requirements for lack of suitably trained applicants. The teaching of trigonometry and solid geometry in the high schools would counteract this tendency and would aid in military and naval education in general. Computational trigonometry and arithmetic should be taught with an emphasis on the use of common sense.

"A proper use of science is derived from an understanding respect, and it is one of the duties of teachers to inculcate this respect. An uninformed or misinformed public is a serious danger in a democracy. We tend to be perilously lowbrow. The rulers of Germany respect scientific facts if not scientific men. Real popular understanding of science in this country goes but little beyond a superficial homage for a few scientific men. In the present crisis we can not avoid the extensive use of scientific men and methods."

The War Preparedness Committee of the two mathematical organizations is attempting to meet some of these problems. One sub-committee has reviewed the basic manuals of military and naval science to determine the amount and nature of the mathematics which they presuppose. Based on these studies, Dr. Morse made recommendations to the group.

DETECTING AIRPLANES AT NIGHT OR THROUGH FOG

RADIO waves about 20 inches long form the fingers which detect invisible airplanes at night, according to a new invention just granted patent 2,231,929 by the U. S. Patent Office. This patent went to Joseph Lyman, of Huntington, N. Y., who assigned it to the Sperry Gyroscope Company, Inc., of Brooklyn.

Repeatedly, reports have come from England that R.A.F. fighter planes have some new equipment enabling them to detect Nazi bombing planes in full darkness. The exact nature of the device has not been revealed, but, judging by Mr. Lyman's description of his invention, it might serve the purpose.

"The novel indicator," he states in the specifications, "is adapted for use on aircraft either for indicating the direction of approach of other aircraft, to thereby prevent collision under conditions of poor or zero visibility, or for use on the ground as when locating aircraft for purposes of gunfire control, or for controlling aircraft landings from the ground, and for other purposes."

He suggests the use of signals of 600 megacycles, or about 20 inches wave-length, because these can be generated and detected by simple means, and are not greatly interfered with by natural phenomena, such as solar radiation. These are about a hundredth of the wave-length of the 6 megacycle signals used for transatlantic short wave broadcasts.

The apparatus consists of a receiving antenna in a parabolic reflector which sweeps around several hundred times a second. At the same time, the axis of rotation itself turns, but more slowly, so that the antenna sweeps all the way around. Because of the reflector it will only receive signals originating in the direction to which it is pointed. Instead of one such antenna, two can be used, one sweeping vertically, the other horizontally.

In peace time, the approaching airplane might have its own transmitter and send out a continuous warning. It can also operate with a transmitter on a defending plane, since the other would reflect the waves from its metal shell. In either event, the receivers pick up the signal only at one instant in their sweep, and this is shown by a spot of light on the end of a cathode ray tube, like that used in television receivers. The position of the spot shows the exact direction of the other plane.

For fire control from the ground, where more bulky equipment may be employed, parabolic transmitting antennas are also used, which turn in step with those of the receiver. This is more efficient, because the signals are sent only in the direction where they will be detected, not broadcast.—JAMES STOKLEY.

THE PRODUCTION OF TOLUOL

TOLUOL, basis of TNT, which is trinitrotoluol, and other chemicals important in preparing for American defense, will be aided with new formulas announced at the New York meeting of the American Institute of Mining and Metallurgical Engineers. They were developed by Dr. H. H. Lowry, director of the Coal Research Laboratory of the Carnegie Institute of Technology, with the assistance of H. G. Landau and Leah L. Naugle.

These formulas make it possible to determine accurately in advance the properties and amounts of coke and by-

products obtained from the carbonization of coal. The chief by-products are tar, gas, ammonium sulphate and light oil. The latter is the raw material from which toluol is obtained, but all the others are important also in defense industries.

In addition to giving scientific control, which assures more accurate planning in the production of the coking by-products, Dr. Lowry's work also makes possible greatly increased economy, by eliminating expensive oven tests. One steel company alone, he stated, has been able to save many thousands of dollars in the single item of eliminating the sulphur analysis of coke.

Carrying Dr. Lowry's work a step further, M. A. Mayers and H. G. Landau, also of the Coal Research Laboratory, announced a method for controlling the properties of pig iron and the economy of its production in blast furnace operation. This method ascertains the particular qualities in the coke necessary to produce certain qualities and quantities of pig iron under specific conditions of operation and ore analysis.

Formulas were developed in this research whereby for the first time blast furnace operators may calculate the quality, economy and rate of production of pig iron from the properties of the coke used. For these calculations preliminary data, defined in the paper, must be collected on each specific blast furnace operation.

SYMPHONY ORCHESTRAS AND BRASS BANDS

THAT brass bands keep their music to the standard pitch better than symphony orchestras, is reported by O. J. Murphy, of the Bell Telephone Laboratories, in the *Journal of the Acoustical Society of America*. However, his studies, based on broadcast music, included only three brass groups, compared with nineteen symphonies. Had he included as many of the bands, their variations might have been much greater.

Almost universally, he found a tendency of the orchestras to rise during a concert. In the case of four leading symphonies (which he does not identify by name) the greatest change was 2.5 cycles per second for the A note in the treble clef. For all the orchestras the variation was about twice as much, or 4.7 cycles. The change of 2.5 cycles represents about a tenth of a half-tone, or the difference between A and A sharp.

In 1925, the Music Industries Chamber of Commerce and the American Standards Association adopted the equal tempered chromatic scale, with A at 440 cycles per second. On this scale A flat is 415.30 cycles and A sharp 466.16 cycles. Mr. Murphy's measurements were intended to determine how closely the musical performers of the United States are adhering to this standard.

For his determinations, he used an electric filter on his radio set, which passed the vibrations ranging from 420 to 460 vibrations per second and included only the A note. This was compared with a standard oscillator. This, in turn, was checked regularly with the National Bureau of Standards broadcast, which sends out a standard 440 cycle note continuously.

A series of measurements comprising some 750 observations was made on various types of musical programs. The mean value of the pitch for all observations was 441.3 cycles per second and the extremes observed were 434 for a dance band and 448 on two occasions for string quartets. Approximately 70 per cent. of the observations were from 439 to 443 cycles per second.

The most accurate instrument, judging from the studies, is the electric organ, of which eight were measured. The mean was 439.9 cycles for the A note, with the minimum 437 and the maximum 440.9. Pipe organs ranged from 435.5 to 442.

BEAVERS, MINKS AND MARTEN

THAT fur-bearing animals merit much more attention than they have been getting from conservationists, was reported by Frank C. Ashbrook, of the U. S. Fish and Wildlife Service, at the sixth North American Wildlife Conference, meeting in Memphis.

Failure to take fur resources into account will, Mr. Ashbrook believes, result in the ultimate failure of the entire movement, for there is not sufficient revenue in sight from other sources to pay for adequate administration of all wildlife refuges in the United States.

Exclusive attention to intangible values, like hunting and fishing for sportsmen, and esthetic satisfaction for the touring public is not enough. Despite the persistent classification of fur-bearing carnivores, like mink and marten as "vermin" by some old-fashioned game wardens, and despite the temporary nuisance value of beaver where they become too numerous, the hard cash realizable from their pelts will justify their existence to a great many farmers and through them to many public officials who control the public purse-strings.

Beaver can be "managed" as are other animals, both wild and domestic, so that they will not remain nuisances, but will become permanent assets both in cash returns and in value as water conservation agents, was pointed pointed out by Victor B. Scheffer, also of the U. S. Fish and Wildlife Service. Humane traps that permit conservation workers to capture them alive make possible the transplantation of beaver into the places where they will do the most good and the least mischief.

The hard-cash value of the fur crop was stressed by Douglas E. Wade, of the University of Missouri. Over twelve trapping seasons in one state (Pennsylvania), the average annual take was more than a million pelts, with a value approaching a million and a quarter dollars.—FRANK THONE.

HAIR SIZE IN RACES AND INDIVIDUALS

THE device of a government investigator for measuring sheep's wool has given anthropologists a new idea for measuring the tiny breadth of human hairs with such speed that in ten minutes they can gain facts about hair size that used to require two days' tedious work.

Speeding study of racial traits with the new technique, Dr. Morris Steggerda and Mrs. Ruth Eckhardt, of the Carnegie Institution of Washington, have already set tentative standards of hair sizes for races. Even varied sizes of hair on an individual's head can be charted to show his own limits of hair size in microns, or thousandths of a millimeter. Hair size variation in individuals and races is found to be very great.

The first studies, made with hair of the Mayan and Navajo Indians, Negroes and Dutch, because adequate hair samples were available, have been announced. "It is evident," according to Dr. Steggerda, "that the Maya have the largest hair in cross-section, and the Dutch the smallest, with the Navajo and the Negro approaching the Maya very closely."

For the first time it is explained that it is possible to analyze also the hair shapes of different races statistically. Negro hair is the most elliptical in shape of any he has studied. Mayan hair is the roundest. The method adopted for investigating racial and individual differences in hair was originated for wool research by Dr. J. I. Hardy, of the U. S. Department of Agriculture.

Hairs are prepared for testing by washing in carbon tetrachloride and drying, and are made into tiny samples by inserting them in packs of 150 to 200 in a slot in metal, in which the hair tips can be coated with thin solution of celluloid. Once hardened, the tiny hair specimens are cut off with a razor blade and are ready to be measured by aid of a microscope.

BLOOD TRANSFUSION GIVEN BY BONES INSTEAD OF VEINS

THAT blood transfusions can be given through the bones as well as through the veins has been found by Dr. L. M. Tocantins and Dr. J. F. O'Neill, of Jefferson Medical College and Hospital in Philadelphia.

According to their report to the Society for Experimental Biology and Medicine, in seventeen trials of this method on fourteen patients there was one failure.

Substances injected into the bone marrow enter the blood stream apparently unchanged and almost as rapidly as when injected into the veins.

Bones will not supplant veins as a route for introducing blood or other substances into the bodies of patients. In some conditions, however, it is difficult or impossible to inject into the veins. Wide-spread mutilations, burns, dropsy, shock and poorly developed or obliterated veins are conditions in which the bone transfusion route may prove vitally useful. In little babies the veins are usually so poorly developed that injections are difficult or impossible.

Blood is not the only substance that can be given through the bones as well as through the veins. Sugar solutions for patients whose blood sugar has reached dangerously low levels, blood plasma which is now being used as well as whole blood for transfusions, and salt solutions to maintain the necessary amount of fluid in the bodies of patients too sick to drink water, may also be injected through the bones.

The blood or other substances are injected into the marrow of the bones where blood cells are formed, and presumably make their way into the blood stream as the blood cells do. The breast bone, collar bone, thigh bone and shin bone were used for the injection in the cases reported.—JANE STAFFORD.

ITEMS

AN octopus species from the Galapagos Islands, hitherto unknown to science, has been named *Octopus roosevelti* in honor of President Roosevelt in a new Smithsonian Institution publication prepared by Dr. Helen G. Stuart, of the University of Southern California. Specimens of the animal were brought back by Dr. Waldo L. Schmitt, of the U. S. National Museum, who was on the presidential cruise among the islands in 1938. A number of other marine species captured on this cruise have already been given the name roosevelti.

WHOOPING cranes, an almost extinct species, show a slight increase in population on the Aransas National Wildlife Refuge in southeastern Texas. This season's count is 26, as compared with 22 last year. The total number of whooping cranes now in existence is not known, for the bird is very retiring and lives in places as remote from man as possible. Estimates vary from as few as eighty survivors to as many as two hundred.

IT is very bad for pigs to let chickens stray into their pens, the U. S. Department of Agriculture warns. Chickens are carriers of avian tuberculosis, to which swine are more susceptible than the fowls themselves. This has been proved in experiments carried out by the Bureau of Animal Industry, at the Beltsville, Md., Research Center. Fifty chickens and thirty-one hogs, all reacting negatively to the standard tuberculin test, were penned with fifty chickens known to be tubercular. They were kept together for a year, when the tuberculin test was repeated. Positive reactions were obtained from 93.5 per cent. of the hogs, whereas only 54 per cent. of the previously non-tubercular chickens reacted. The remedy is obvious and simple. Keep all chickens, even apparently healthy ones, away from the pigpens.

FOREST cuttings now wasted can be used in new kinds of wood stoves that will operate for many hours without attention. Such use can be made an important aid to conservation, L. E. Seeley and F. W. Keator, of Yale University, reported at a session of the fuels division of the American Society of Mechanical Engineers. They emphasized the importance of "space heaters." These are small units for home use to heat the room in which they are installed, and adjacent rooms through the movement of air through communicating doorways. This arrangement, they said, is used in about 45 per cent. of one- and two-family homes in cities and is even more widely employed in the country. When forests are cut for timber, "30 to 40 per cent. of the wood, constituting the branches and trimmings, is useless as timber." Use of this for heating would aid greatly in efficient maintenance of the forests. In the new types of heaters, described by the speakers, the burning is only at the bottom of the pile after they have been started. The heat, however, converts the upper wood into charcoal. As ashes drop through the grate into the pit below, fresh charcoal is automatically fed to the burning zone. The heater requires attention only occasionally, to refill the wood reservoir. The ashes are removed every few days.

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Teachers were enthusiastic about the first edition of this successful text; they like the second edition even better, commenting particularly on the retention of the logical, systematic organization of material, the new sections on the parasites, the revision of the treatment of Annelid worms, and the wealth of new illustrations. As before, teachers find that *Animal Biology* fits exceptionally well into their courses, without stressing too heavily either the "types" or the "principles" approach.

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SCIENCE NEWS

Science Service, Washington, D. C.

MATHEMATICAL STATISTICS SPEEDS MASS PRODUCTION

MATHEMATICS can aid America's defense production in many ways, it was stated at the Symposium on Applied Mathematics, held by the American Mathematical Society at Columbia University on February 21. The speeding of mass production by showing the most efficient way of producing parts of a specified tolerance and determination of the most efficient design of airplane wings were cited among other instances.

Dr. Walter A. Shewhart, of the Bell Telephone Laboratories, discussing "Mathematical Statistics in Mass Production," said that "a basic engineering problem in mass production is to devise an operation of using raw and fabricated materials which, if carried out, will give some particular thing wanted. The specified tolerance ranges for the quality characteristics of the thing wanted are the engineer's target. He devises a production operation and predicts that it will hit the target if carried out; but, since he does not have certain or perfect knowledge of facts and physical laws, he can not be sure that a given operation will hit its target. In fact, the best that he can hope to do is to know the probability of hitting the target. Here then is a fundamental way in which probability enters into everything that an engineer does. "Furthermore, if the thing produced fails to meet tolerance requirements, the engineer is penalized in one way or another. For example, if the quality of any piece-part fails to meet its tolerance requirements, a loss is incurred through rejection or modification of the defective part. If the time-to-blow of a protective fuse fails to meet its tolerance range, loss of property and even loss of life may result. If the time-to-blow of a fuse in a shell fails to meet its tolerance range the shell may even burst within the gun and kill members of the gun crew, and, in any case, will fail to fulfil its function of destruction within the ranks of the enemy."

By using statistical control, he explained, it is possible to provide "a technique for modifying and coordinating the three fundamental steps in the process of mass production, namely, specification, manufacturing and inspection, so that the maximum number of pieces of product having a quality within specified tolerance limits can be turned out at given cost. It does this by showing how to minimize the cost of inspection and the cost of rejection. Statistical theory plus mass production provides a means of maximizing our physical comforts in time of peace and our strategic factors in time of war."

RADIUM-LIKE CARBON MADE FROM NITROGEN

MODERN alchemy, which turns one element into another, has now made from nitrogen a form of carbon which promises to have important uses in medicine and other sciences, announce two researchers at the University of California.

This kind, or isotope, of carbon is of mass 14, somewhat heavier than normal carbon, principally composed of the isotope of mass 12. Unlike ordinary carbon, the new kind, C–14, gives off beta rays, one kind of radiation emitted by radium. It consists of atomic fragments called electrons. C–14 does not, however, give off gamma rays, which resemble x-rays, and are responsible for the medical effects of radium.

In a report to *The Physical Review*, Dr. Samuel Ruben and M. D. Kamen, of the University of California, reveal their success in preparing appreciable quantities of C–14 with the cyclotron, or "atom smasher," of the university.

For six months two five-gallon carboys of a concentrated solution of ammonium nitrate, in which no carbon is present, were exposed to a constant rain of neutrons from the atom-smasher. Some nitrogen atoms, which have the same mass as C–14, were converted into the carbon isotope. These were extracted in the form of various carbon compounds. Their radioactivity was tested by means of a Geiger counter, which detects the beta rays. The samples showed considerable activity, far more than any of the materials used originally, before the bombardment with neutrons.

It is expected that C–14 will prove important as a tracer element, in medical and botanical research, and it may be prepared commercially in large quantities for such use. Carbon is the most wide-spread element in living organisms. Ordinarily it is not possible to distinguish one carbon atom from another, but radioactivity forms a tag for identification. If C–14 atoms are introduced at one part of a living organism, they can be located elsewhere by their effect on a Geiger counter. Another advantage of C–14 is that it has a long life. Continually giving off energy, radioctive elements are gradually used up. C–14 disintegrates so slowly that after 1,000 years there will still be at least half of the original quantity remaining.

Dr. Ruben and Mr. Kamen point out that in some ways the long life of C–14 is unfortunate, since it requires a long time to prepare it. They point out, however, that there are methods for concentrating it from the other isotopes. In addition, they suggest, end products of a reaction in which it is used can be collected, the C–14 reconcentrated, and used over again.

P-RADIATION

CLOUDS of bullets which are continually shot from the sun make it possible for radio waves to travel long distances by night as well as by day.

Recent studies by the staff of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington have revealed new facts about these material particles which cause the aurora borealis and are mainly studied by their effect on the magnetic condition of the earth.

These particles travel across the 92,900,000 miles separating sun and earth much more slowly than the visible and invisible light waves, which make the trip in about eight minutes. That is why they produce an effect at night.

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This effect is only in the daytime hemisphere—that which faces the sun, yet the radio ceiling persists into the night. But the particles being slower, even the night time part of the earth is constantly running into them, and the effect, in ionizing the upper atmosphere, is similar to that of the light waves.

The bombardment is described, in a statement issued by the Carnegie Institution of Washington, as "coming in clouds of particles, of various sizes from mere wisps to diameters many times the earth's radius, which form a more or less continuous stream, perhaps of the structure of a string of pearls and in shape like the arms of a spiral nebula."

This "P-radiation," as the stream of bullets is called, is presumed to come from hypothetical "M-regions" of great activity on the sun's surface.

AERIAL PHOTOGRAPHS

AERIAL photographs, taken and printed in the air within seven minutes after exposure, are among the latest accomplishments of technicians of the U. S. Army Air Corps at Wright Field.

By making the pictures so rapidly, then dropping them to the ground in a metal container to which a streamer is attached to make it easy to find, information gained on flights over enemy territory can be quickly delivered to headquarters. Hitherto, the general practice has been for the plane to land with the undeveloped films, which were then finished.

According to H. F. Stiffler, Wright Field mechanical engineer, who describes the new system in an Air Corps publication, the advantage of such a system has long been realized, but earlier attempts were held back, chiefly through lack of interest, and also because of the danger to airplane structure and controls caused by corrosion from the photographic chemicals.

In 1939, he says, the photographic laboratory at Wright Field experimented with a quick-work unit that made pictures on reversal-type paper instead of film. In the developing process, a positive print could be obtained without the intermediate stage of a negative.

Disadvantage of the method was that the paper is much slower than aerial film, so exposures could only be made under fairly good lighting conditions. In addition, its processing requires close regulation of the temperature of the solutions. This made necessary tanks with automatically controlled cooling and heating units.

High-speed film is now used, with processing solutions that work satisfactorily in temperatures as warm as 80 degrees Fahrenheit. The film holder is made of materials that are not affected by the solutions, which are contained in five half-gallon tanks, each with a trap door lid that keeps light out and prevents splashing.

After a piece of the film has been exposed and the dark slide of the holder is closed, the holder is removed from the camera and inserted in the first tank, which contains the developer solution. The dark slide is then withdrawn. After one minute in this tank, the dark slide is again closed and the holder transferred to the second tank, and so on until the processing is complete. The wet negative is removed from the holder and placed on the printer.

In printing, a thin piece of clear film over the negative keeps the paper dry. It is then placed in a dry film holder. This is then put through the five tanks, just like the original film. The final result is the finished print which is dropped to the ground, still wet, in the metal container. While the present equipment is still in the experimental stage, satisfactory prints have been produced with it while in flight in seven minutes from the time of exposure of the films. Tests indicate that a satisfactory solution to the quick-work program is within sight, and it is expected that standardization and procurement for a service test will be accomplished in the near future.

TOXOPLASMA

THE deaths of two adults and one six-year-old boy from infection with Toxoplasma, and a non-fatal case in another little boy, are reported in the *Journal* of the American Medical Association. The ailment may or may not be rare. How often it occurs is one of the unknowns in the problem.

The two little boys had "atypical encephalitis," according to Dr. Albert B. Sabin, of the Children's Hospital Research Foundation and the University of Cincinnati College of Medicine. Encephalitis means "sleeping sickness" to most laymen, but they did not have typical sleeping sickness. Convulsions, fever, disorientation and an increased number of a certain kind of white blood cells in the spinal fluid were the chief features of the disease.

In the adults, the ailment might have been mistaken for Rocky Mountain spotted fever or endemic typhus fever, according to the report of these cases by Dr. Henry Pinkerton and Dr. Richard G. Henderson, of the St. Louis University School of Medicine. Rash, fever and lung involvement were the outstanding features in these cases.

Toxoplasma, the "germ" that caused these quite different ailments, was first discovered in 1908 in the gondi, a North African rodent. Since then it has been found in many animals, such as guinea pigs, rabbits, rats and mice, and has been reported as causing disease in man. Hitherto, it has been doubted that Toxoplasma could or did cause sickness in man because the evidence in the earlier reports, with one exception, was inconclusive. Now, however, the proof is more definite. Both Dr. Sabin and Dr. Pinkerton and Dr. Henderson report laboratory tests, including transmission of the disease to guinea pigs by inoculation with blood or spinal fluid from the patients, which are pretty convincing evidence that the Toxoplasma caused the illnesses.

How the patients got the disease is part of the mystery that remains to be solved. In the cases of the two adults, there was a suggestion that ticks, such as transmit Rocky Mountain spotted fever, might be responsible. A cat in the home of one of the little boys became sick and had

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By William C. Beaver. 2nd Ed. 889 pages, 301 illustrations, 14 color plates. Price, $4.00

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convulsions about the time the child got sick. This was suggestive, but the cat had been disposed of, so no tests could be made to determine whether it also was infected with Toxoplasma. Mosquitoes had been troublesome around this home, but no ticks had been seen. Some cases of Toxoplasma infection have been reported in infants and it was thought these babies got the sickness from their mothers, although the mothers themselves did not have it. Because the two adults who died of toxoplasmosis had lung involvements, it is pointed out that the ailment might be transmitted directly from person to person.

The disease is probably relatively rare, although there is as yet no indication how frequent such infection is. Owing, however, to its similarity to recently reported cases of atypical pneumonia of unknown cause it is not at present justifiable to assume that it is a rare disease.

Treatment so far has been directed to relief of symptoms, but Dr. Sabin's report indicates that the newer sulfa drugs may prove effective. He gave sulfanilamide to one of the little boys, but without success. Later tests with mice showed that sulfapyridine and sulfathiazole have a curative effect on the infection in mice, but that sulfanilamide "only delays death but can not prevent it."

BLOOD IN PHARMACEUTICAL STANDARDS

BOTTLES and flasks of vital red fluid stored in hospitals for emergency lifesaving may in the future bear labels reading: BLOOD U. S. P. The three letters are initials for the Pharmacopoeia of the United States, and when they are on the label of a bottle the contents of that bottle must, by law, come up to the standards described for the substance in the Pharmacopoeia.

Whole blood, blood serum and blood plasma for transfusion are recommended for inclusion in the twelfth revision of the Pharmacopoeia, according to Dr. E. Fullerton Cook, chairman of the revision committee of the U. S. Pharmacopoeia. The Pharmacopoeia is revised every ten years, with occasional interim revisions to keep up with the rapid development of scientific knowledge.

Quinine, according to Dr. Cook's announcement, may come out of the next Pharmacopoeia. Physicians now-a-days seldom prescribe quinine for treatment of malaria. Instead, they prescribe various salts of quinine such as quinine sulfate. These will remain in the Pharmacopoeia.

Antipneumococcus serum, immune serum for scarlet fever, and immune serum for measles are recommended for the U. S. P. XII. So is tetanus toxoid. Among other articles recommended for inclusion are radium, nicotinic acid amide, halibut liver oil, vitamin A and D in oil, riboflavin (one of the B vitamins), and cortin, an adrenal gland extract used in treatment of Addison's disease. Extract of rice polishings, standardized for vitamin B_1 potency for use in the Philippines, is also recommended for inclusion.

Among recommended deletions of articles now in the Pharmacopoeia are such standbys as asafetida, cantharides, capsicum, pepsin, iodoform, powder of ipecac and opium, creosote and one reminiscent of the world war surgery, modified Dakin's solution.—JANE STAFFORD.

ITEMS

BY shooting high energy atomic bullets, or neutrons, at them, University of California physicists have succeeded in breaking the nuclei of both uranium and thorium atoms into equal parts, it was announced recently. Importance of this is that the form of uranium used is of mass 235, the kind that, it is hoped, will make possible practicable atomic power with such a splitting or fission process. In previous experiments, by using slow-speed neutrons, uranium was divided very unevenly, into a light element and a heavy one. However, Dr. Emilio Segre, of the Radiation Laboratory, and Dr. Glenn Seaborg, instructor in chemistry, used high-speed neutrons, with energies of 16 million electron volts, or more than three times that used earlier. These neutrons are produced by bombarding atoms in the cyclotron or "atom-smasher." In the splitting process, energies of 100 million or more volts are produced. Difficulty of separating uranium of mass 235 from the ordinary kind, which contains it in rather small amounts, has so far prevented actual tests of uranium power.

THE star Sirius, changing in color from red to light green, was the startling sight observed recently from a ship in the tropical Pacific Ocean, west of the Galapagos Islands. In a report to the Hydrographic Office of the U. S. Navy, the observer, whose name and ship are not revealed, says that he was taking a sight on the star, when he noticed the color changes. Then he looked through binoculars, "and it was found that nearly all the colors of the spectrum were included in its changes." Sirius was then just rising in the east. As it climbed higher the colors faded. Such an effect is an exaggerated form of the familiar twinkling. As the star's light passes through regions of the air of different temperatures it is bent one way, then another. When the temperature differences are unusually great, the air acts as a prism, and spreads the beam out into an actual spectrum. Because of the movement of the air and also, in this case, of the ship, the observer sees changing parts of this spectrum, and hence the changes of color.

DEADLY to apple worms, harmless to bees, is a new virtue found in the new poison-spray material, phenothiazine, now being tested by the U. S. Department of Agriculture. The discovery is subject of a joint report by L. M. Bertholf, of the Bureau of Entomology and Plant Quarantine, and J. E. Pilson, of Western Maryland College. One of the great problems involved in control of the worst of apple enemies, the codling moth (whose larvae are the "worms" found in apples), is the deadliness to bees of the arsenical sprays commonly used. In these tests, bees were given heavy doses of phenothiazine without any apparent ill effects. In contrast, minute doses of calcium arsenate proved deadly, and lead aresnate was also an active bee poison in the doses bees are likely to get in gathering pollen from sprayed orchards. Phenothiazine is not yet recommended for general use in orchard spraying, because thus far it has not produced uniform results on the codling moth larvae. It is hoped that further experiments will make it more completely dependable.

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The cost of the Polarograph has been reduced from $750.00, which was the price for the former model, to $550.00 for the new Model XI.

Two publications pertaining to polarography will be available for distribution within the next few weeks. One explains in detail the principles of applied polarographic analysis, essential instrumentation, care and maintenance of the instrument, its operation and the technique of the dropping mercury electrode and cell. The other is a bibliography of more than 700 papers dealing with polarographic analysis. Both publications are available without charge on written request.

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SCIENCE NEWS

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THE 1941 APPORTIONMENT BILL

CONGRESS is engaged in a struggle to make democracy work on the best mathematical basis, and mathematicians on the sidelines are rooting for the method of equal proportions instead of the method of major fractions. It is a matter of reapportioning the seats in the House of Representatives, always a sore subject because it may legislate some present representative out of his job or so warp his district that he has to start building his political fences in unfamiliar territory.

Because the number of seats in the House is fixed at four hundred and thirty-five and the country continues to grow in population, new standards should be set with each census. It is now time to make the changes based on the 1940 census.

Determining just what states shall have how many representatives has been done by the method of major fractions in the past. This mathematical procedure has been vigorously attacked by mathematical authorities, led by Dr. E. V. Huntington, professor of mechanics at Harvard University.

The 1941 apportionment bill, H.R. 2665, has passed the House and is about due to come up in the Senate, which is not directly concerned because the number of senators remains two from each state regardless of how the country grows. If this equal-proportions bill does not pass the Senate, however, the now out-dated method of major fractions will be used in allotting the representatives. "The retention of the method of major fractions in the 1941 apportionment would imply the complete abandonment of any attempt to equalize the congressional districts among the several states" in the opinion of Dr. Huntington.

If the Congress desires to equalize both the congressional districts and the number of representatives per million inhabitants among the several states the method of equal proportions will always give a better result on a percentage basis. But it faces a dilemma when it desires to measure the inequalities by absolute differences instead of by the more natural percentage differences. For minimizing the absolute differences between the numbers of representatives per million, the major fractions method is better. For minimizing the absolute differences between congressional districts, the equal proportions method is better.

The mathematicians say that the very plausible desire to make the congressional districts in each state differ as little as possible from a population of 301,164, the average congressional district for the country at large, just won't work because it leads to a mathematical paradox. It is just as easy for the Bureau of Census, which makes the computations, to figure the problem of what states will have the House seats by major fractions or equal proportions.

Here's a test computation under the two methods: Michigan has a 1940 population of 5,256,106, Arkansas has 1,949,387. Under the method of equal proportions, Michigan would have 17 representatives with 309,183 to a district and Arkansas would have 7 with 278,484 to a district. This is an absolute difference of 30,699 and a percentage difference of 11.02 per cent. By the method of major fractions, Michigan would have 18 with 292,006 to a district, and Arkansas would have 6 with 324,898 people to a district. The absolute difference in this case would be 32,892 and the percentage difference would be 11.26 per cent. Thus the inequalities between the congressional districts, whether absolute or relative, is smaller under the method of equal proportions.—WATSON DAVIS.

THE NAUTICAL ALMANAC

DESPITE the war, foreign governments are still collaborating with the United States in producing the astronomer's bible, "The American Ephemeris and Nautical Almanac," published each year by the U. S. Naval Observatory.

The Ephemeris gives detailed tables of the positions of the sun, moon, planets and bright stars, information about eclipses, lists of observatories and other information that is essential to the astronomer. The volume for 1942 has just been released, so students of the heavens can now, if they wish, make plans for the coming year.

The director of the Nautical Almanac Office is Dr. W. J. Eckert, formerly of Columbia University, who assumed this post last year following the retirement of the former head, Dr. James Robertson.

Writing in the preface to the 1942 volume, Captain J. F. Hellweg, U. S. N. (retired), superintendent of the Naval Observatory, states that the tables showing the positions of Saturn's rings, and the times when his moons are best seen, were furnished by the *Berliner Jahrbuch*, the corresponding publication of Germany.

The office of the similar French work, the *Connaissance des Temps*, furnished the tables of Jupiter's satellites. From the British Nautical Almanac office came tables of the positions of the sun, moon and planets. As in the volume for 1941, however, the name of the Spanish Almanaque Nautico is missing. For 1940 they furnished star positions.

Cooperation of the U. S. Nautical Almanac with foreign offices was authorized by the Congress in the 1912 Naval Appropriation Bill. This eliminated much needless duplication of work in the various countries. This act provided, however, that the work on the Ephemeris be so conducted that, in emergency, all the tables needed for the navigation of American ships, both naval and commercial, could be prepared without any foreign assistance. This principle has been carefully followed ever since.

Only two eclipses of the sun are scheduled for 1942, the Ephemeris indicates. One is on March 16–17, visible near the South Pole, the other on September 10, near the North Pole. There will be three eclipses of the moon, two partial and one total on August 26. This will be seen throughout North America. Also, on a number of occasions during the year, the moon will "eclipse," or occult, the bright star Aldebaran.

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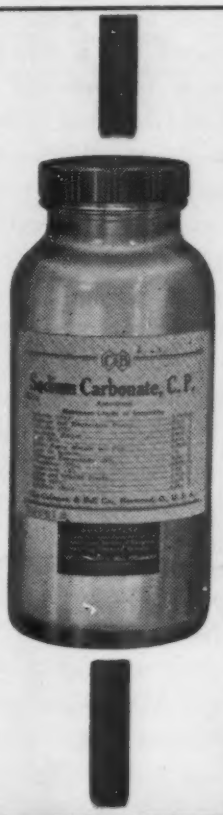

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THE CANADIAN OIL SUPPLY

COMMERCIAL production of oil will soon begin from one of the world's greatest reservoirs, known for a century and a half, but inaccessible until now on account of transportation troubles. This supply is located in northern Alberta, about 300 miles from Edmonton. Within the next few months, the first commercial extraction plant is expected to be in full operation with the production of gasoline, Diesel fuels, fuel oils, asphalt and coke from the oil sands.

The Alberta oil sands, according to Canadian Government geological estimates, contains at least 100 billion barrels of oil. The United States Bureau of Mines estimates the field contains 250 billion barrels. Other estimates place the gasoline supply of this field at 35 billion barrels. Economically it is figured that only one per cent. of the oil reserves of this area can be exploited at present. The field is roughly located along the Athabasca River, and the present industry to extract oil from the sands is at McMurray, at the railhead.

A number of companies have tried to extract the oil from the sands along the shores of the Athabasca River where stripping has shown the oil sands close to the surface. One of these companies has been building a plant near McMurray since 1936, using new processes and machinery devised in the United States. This company expects to start commercial production soon.

It took eleven years of research work to develop the present method of separating the oil from the sand. The oil forms the sole cementing material of the sand and is in the form of a film around each grain of sand. Mild abrasion and warm water break the film and give a pulp of water and sand through which are disseminated particles of oil. In a properly designed flotation cell the oil particles are picked up by air and form bubbles that float to the surface. The froth thus formed is high in mechanically entrained water and mineral matter. It will not settle out on account of the high viscosity and specific gravity of the oil, but does so quickly when the crude oil is diluted with naphtha or kerosene, leaving a clean oil readily pumped through a pipe line.

The deposits have been known since 1788 when the first explorers of the region found Indians using the oil with pitch to caulk their canoes. These oil-saturated sands range in thickness from a few feet to 225 feet, and in oil content up to 25 per cent. by weight. They cover an area estimated variously from 10,000 to 50,000 square miles of northern Alberta.

PLANT FOSSILS IN ARIZONA

CLIMATIC conditions like those in parts of modern Ethiopia prevailed in the American Southwest 170 million years ago, when the long reign of the dinosaurs and their great reptilian kin was just beginning. This is indicated by fossil plant remains in one part of Petrified Forest National Monument in Arizona, of which a study has been made by Dr. Lyman H. Daugherty, of San Jose State College in California. Dr. Daugherty's report has just been published by the Carnegie Institution of Washington, along with a description of the geology of the region by Howard R. Stagner, of the U. S. National Park Service.

Dr. Daugherty states that the forests of Arizona in early dinosaurian days (Triassic, to geologists) were dominated by great tree ferns and relatives of modern conifers. Higher flowering plants of the broad-leaved types were not to make their appearance for many millions of years. However, plant evolution was going on quite rapidly, as the saurians lumbered on to the scene.

Presence of tree ferns argues a warmer climate than that of present-day Arizona; it was a warm-temperate or subtropical world. Conifer tree trunks show very sharply marked annual rings, indicating an abundance of rain during part of the year, followed by a severe dry season in which no growth took place. The great size of the petrified logs indicates a climate far better suited for tree growth than is the present climate of the Southwest.

Dr. Daugherty has come to the conclusion that in Triassic Arizona there were moist stream valleys with thick, jungle-like forests, with plateaus between them supporting lower vegetation with scattered trees. This kind of formation, called savanna by ecologists, is characteristic of parts of Ethiopia and other regions in Africa, as well as of certain areas on the outskirts of the great central tropical forest mass in South America.

Evidence of forest fires in the ancient woods was found in the form of boat-shaped log fragments crusted with fossil charcoal. However, no healed-over fire scars have been found to indicate that trees suffered fire injury while living.

SOY BEAN PLASTIC

"WOOL" from the soy bean will shortly be adopted for automobile upholstery padding, just as plastic fiber panels will replace steel for the automobile body.

Robert Allen Boyer, head of the chemical laboratory established by Henry Ford for research with soy beans, has developed in the laboratory a soy protein fiber processed with sprayed rubber which makes a springy, durable padding for automobile seats.

"The soy wool is the only protein fiber thus far developed from a vegetable source. All other protein fibers come from animal protein. You are reasonably sure of a good crop in virtually all agricultural parts of the world. Two acres of land devoted to sheep grazing will produce eight to ten pounds of wool per year. Two acres of land in soy beans will produce 400 pounds of protein suitable for fiber."

Henry Ford has a suit of clothes in which the material is 25 per cent. soy bean protein fiber.

With the tensile strength of soy bean plastic now about half that of steel, the Ford laboratories are experimenting to develop panels made with plant fiber, held together with a soy bean resin binder, which will resist blows as well, or better, than steel. Fibers of the ramie plant, which have great tensile strength, are being added to the soy bean plastic where the latter needs greater strength.

By way of illustrating what an automobile door panel, made of plant fiber with soy bean resin binder, will stand in resisting a blow, Ford will strike a panel lying convex side up on the floor with an axe head. With the blunt side of the axe, no dent results; with the cutting edge, a clean cut results, without denting the surrounding sur-

face. A similar blow on a steel door panel will cut through the metal, bending in the edges of the cut and making a large dent in the surrounding metal surface.

The fiber panel weighs only half that of a steel panel, of the same pattern. It is composed of 70 per cent. fiber and 30 per cent. resin binder. The fibrous element is compounded of 50 per cent. southern slash pine fiber; 30 per cent. field cereal straw; 10 per cent. cotton, and 10 per cent. hemp.

Henry Ford states that the entire superstructure of an automobile body, except the tubular welded steel frame, will be made from this tough fiber plastic. The first model will be finished this winter.

ANTI-MEASLES VACCINE

MANY hundreds of children in New Jersey and Philadelphia are now being vaccinated with a new and promising anti-measles vaccine, and Army medical authorities are considering the advisability of its use among selective service men now in training camps, where measles cases are on the increase. The vaccine is not yet ready for general distribution and use, according to Dr. Geoffrey Rake, of the Squibb Institute for Medical Research at New Brunswick, N. J. Dr. Rake, with Dr. Morris F. Shaffer, developed the vaccine from measles virus grown on fertile hen's eggs.

The first vaccinations on a small group of children in Philadelphia reported as successful last fall, were conducted under the direction of Dr. Joseph Stokes, Jr., of the Medical School of the University of Pennsylvania. Dr. Stokes is directing the present trials of the vaccine on a wider scale. He is also director of the measles commission of the U. S. Army which is being formed and will at its first meeting consider the use of the vaccine in Army training camps. Dr. Rake and Dr. Shaffer have been asked to join this commission.

The vaccination of children in New Jersey and Philadelphia orphan homes, schools and similar institutions had been planned before the present outbreak of measles started. It was delayed for six or eight weeks, however, by the influenza epidemic which struck all the institutions selected for the measles vaccine trials.

Dr. Rake said that the program is now going ahead and that a good start has already been made. He hopes that the vaccinations, in spite of the eight weeks' set-back due to the flu, will be completed in time to protect the children during the present epidemic. Children in institutions usually get measles six to nine months after children in the rest of the population, because such children are relatively isolated.

The vaccine will be given to half the children in the selected institutions, the other half remaining unvaccinated. This will give a control group against which to check the protective value of the vaccine. Only children who have never had measles have been selected for both control and vaccinated groups. Permission of parents or guardians is being obtained before the vaccination is done, and about half of the parents or guardians have given this permission, so that there has been no need to draw lots or follow any other method for division of the children into vaccinated and not-to-be vaccinated groups.

Among the questions that it is hoped to answer by the vaccine trials is how long and how completely the vaccine protects against measles. Until such questions are answered, the vaccine will not be released for general distribution.—JANE STAFFORD.

ITEMS

CARLILE P. WINSLOW, director of the U. S. Forest Products Laboratory, at Madison, Wis., suggests that hardwoods from the forests of tropical America should be called upon to replace some of the Old World tropical woods now becoming difficult to get because of war conditions. Mr. Winslow recommends a program of research on these woods, to learn their qualities and adaptability to American needs, since with the exception of mahogany, Spanish cedar, several dyewoods and a few other varieties, most of the American tropical hardwoods are still wholly unknown in this country.

TREE surgeons now have available an instrument that will do for them what the stethoscope does for physicians. The new method is a result of the discovery made by Thaddeus Parr, of the U. S. Department of Agriculture, that there is a slight difference in electrical potential between the top and the root of a tree. During the time of fastest growth in spring, this gradient is from top to root; later, it reverses its direction. But in a tree seriously injured by insects or otherwise in bad health, the reaction is abnormal, being either weaker than in a sound tree or reversed in direction. A comparatively simple but very sensitive voltmeter has been developed, that can be carried into the woods, so that field diagnoses will be readily possible.

CARNATIONS are being killed by a new disease, caused by an apparently unknown bacterium. The malady made its first appearance in a greenhouse at Spokane, is reported in *Phytopathology* by Leon K. Jones, of the State College of Washington. Characteristic of the new malady is the production of grayish-green foliage, followed by yellowing and death of the plants, similar to the symptoms commonly associated with the wilt disease. Yellow streaks of frayed tissue in the woody areas, extending 12 to 24 inches up the stems of affected plants, are distinguishing symptoms. The disease is most damaging during warm weather of fall and spring. W. H. Burkholder, plant pathologist at Cornell University, New York, is studying the bacterium to determine its exact identity.

SUCCESS in giving the anti-bleeding vitamin K by injection into the veins of patients too sick to take it by mouth has been announced by Dr. Edward R. Anderson, Dr. John E. Karabin, Dr. Herbert Udesky and Dr. Lindon Seed, of the University of Illinois College of Medicine and Cook County Hospital. In 17 out of 18 patients the injection of a water-soluble compound with vitamin K activity was effective. Failure in the eighteenth case was ascribed to the fact that the patient's liver, necessary for utilization of vitamin K by the body, had been completely destroyed by illness. Injection of the vitamin brings a quick response. The injection eliminates the need for use of bile salts, which must be given with the vitamin when it is taken by mouth.

The Strange Case of The Invisible Evidence

DEATH had struck in the night.

A fleck of copper on the suspect's knife was the only clue. But with this trifling bit of evidence alone, criminologists using the *spectrograph* were able to prove that the knife had cut copper. By the percentage of constituents and impurities present, they identified that fleck as having come from that specific telephone wire. The case was solved—a murderer convicted.

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Many other species of less importance are also mentioned, making the book one of the most comprehensive treatments of the subject available. At the same time, the book is not so encyclopedic in scope as to prevent quick reference to essentials.

In the revision the material previously included in the opening paragraph describing the more important species has been condensed into tabular form.

For the sake of comparison, the distinguishing characteristics of a group of species have been brought together in one table, making the book easier to teach and easier to use.

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A standard in the field for the past twenty years, this well liked, widely used textbook has been almost entirely rewritten. The explanatory matter has been expanded, some of the illustrative data have been drawn from newer sources, considerable additions have been made to the derivations of important equations, and other changes have been made to bring the treatment in line with current progress.

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SCIENCE NEWS

Science Service, Washington, D. C.

IRIDESCENT COLORS OF THIN FILMS OF TRANSPARENT MATERIAL FOR THE DETECTION OF DISEASE

DIAGNOSING disease may in future be aided by a new method which makes use of the changes of iridescent colors reflected from very thin films of transparent material. Details of the new method which is expected to detect viruses, toxins, poisons and other tiny and invisible substances were explained in an announcement stating that a patent covering the method had been issued to Dr. Irving Langmuir, of the General Electric Research Laboratory.

It is known that thin films of transparent material such as barium stearate, an insoluble soap, reflect iridescent colors. The color depends on the thickness of the film. A film with a thickness of 47/10,000,000 of an inch reflects a purple color when illuminated by a white light. If the film is made slightly thicker the color changes toward blue. The changes in thickness can thus be measured by observing the changes in color.

To detect viruses or other tiny, invisible substances, slides are first conditioned by applying the thin barium stearate film and then dipping in a 1 per cent. solution of thorium nitrate. Then it is possible to apply to the slide a substance that has a specific reaction toward the particular toxin or virus or poison or other substance for which the test is to be made.

If the suspected substance is present in the solution tested, adsorption of a single layer of uniformly thick atoms or molecules of the substance will take place on the slide surface, producing an increase in film thickness and a corresponding change in color.

Each type of substance in solution is expected to produce a characteristic increase in film thickness and corresponding change in color of the conditioned slide. Once these characteristic thicknesses and colors for known substances have been determined, identification of suspected substances will be a matter of check and comparison. Dr. Katharine B. Blodgett and Vincent J. Schaefer, members of the staff of the Research Laboratory have assisted Dr. Langmuir in the investigations, which started in 1935.

ARTIFICIAL RADIOACTIVE SUBSTANCES

DR. GLENN T. SEABORG, instructor in chemistry at the University of California; Dr. J. J. Livingood, formerly research associate in the Radiation Laboratory, and Gerhart Friedlander, graduate student in chemistry, have announced that they have added four artificial radioactive specimens of germanium, an element similar to lead, to those already known, bringing the known total to about 360. Germanium is one of the last of the 92 elements to be investigated in detail for radioactive species.

An artificial radioactive substance is one which is made to emit rays somewhat as radium does. They are made by smashing atoms in the cyclotron. When the atom of an element is smashed it often changes into another element and emits rays which can be detected by the use of sensitive instruments. More than one hundred of the known artificial radioactive substances have been discovered at the University of California with Professor Ernest O. Lawrence's cyclotron. Some of the radioactive elements have proved invaluable in medical and biological research. Radio phosphorus is being used in experiments on the treatment of leukemia, the dread disease of the blood cells. The growth of teeth and bones are being studied by the use of radioactive strontium, radioactive iodine is revealing valuable facts about the thyroid gland, and several other elements treated by the cyclotron are literally throwing new light on biological processes.

Plant growth and nutrition are being studied also by feeding a solution of radioactive elements and following their course through roots, stems and leaves. The use and value of various basic food elements are being studied in animal and poultry nutrition with "tagged" substances.

HEREDITARY CHANGES IN PLANT-SPECIES CAUSED BY ULTRAVIOLET RAYS

ULTRAVIOLET rays demonstrated their capacity to cause hereditary changes in plant species, in experiments by Dr. Alexander Hollaender, of the National Institute of Health, speaking before the Philosophical Society of Washington.

The plants used were members of the group known as dermatophytes, which are parasitic fungi that attack the skin. Cultures of them were grown in glass dishes, and their one-celled asexual reproductive bodies (spores) were irradiated with ultraviolet light of a dozen different wavelengths. The raying was so conducted that on the average each spore received and absorbed a definite quantity of radiant energy.

A considerable proportion of the spores were killed, for ultraviolet is dangerous to these bodies as it is to other living things. Among the survivors many changes were observed, whereas in more than 3,000 control cultures that were left untreated, no mutations whatever occurred. In addition to the mutations, or inheritable changes, there were other changes in both form and physiology of the molds that soon disappeared.

Certain special wavelengths were found to be more effective than any others, both in killing the fungi and (in lighter doses) in causing the mutations. Most effective of wavelengths was one of 2650 Ångstrom units; second in effectiveness were waves 2380 Ångstrom units in length. (The Ångstrom unit is the physicist's "inch" in measuring wavelengths of light and other radiations. The shortest waves of visible violet are about 3000 Ångstroms long.)

Mutations included changes in color, appearance and size of the growth mass or mycelium, spore production and growth rate. Changes proved to be permanent, through long series of culture transfers. Highest mutation rate was more than 20 per cent.; rates of 10 per cent. were obtained "with greatest regularity."

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SYNTHETIC TEXTILE MADE FROM SEAWEED

THE newest raw material from which synthetic textiles can be manufactured is seaweed, according to a report to the American Chemical Society from a British correspondent.

Details have just been reported in England by Professor J. B. Speakman, who has been carrying on researches during the past two years for a British firm. The name of the company is not given, because, it is said, "it has not yet attained large-scale production of the new product and does not wish to be asked for samples at this stage."

In former years, seaweed was collected in the Hebrides to the extent of 400,000 tons annually. Far larger amounts are available from the west coasts of Scotland and Ireland as a whole, so the raw material is abundant and should be very cheap. From the seaweed is extracted alginic acid, which makes up about 20 to 30 per cent. of the dried seaweed. This can be dissolved and then spun in a solution of acid, through spinnerettes like those used in making rayon.

Such fibers, spun in acid, dissolve in soap and soda solutions, and hence are useless as textiles. The alginic acid can, however, be combined with inorganic material in the form of compounds called alginates. These are resistant to alkalies, and constitute the new fibers. They have good luster and strength, and are non-inflammable. In fact, it is said, the fabric can be soaked in gasoline, the latter ignited and burned away, leaving the fabric the same as before this treatment. It costs less to make than viscose rayon.

AIRPLANE MASS PRODUCTION

THE technique of mass production of airplanes "is as far removed from automobile manufacture as the automobile was from carriage building," was pointed out by Henry C. Hill, of the Wright Aeronautical Corporation, at the National Aeronautic Meeting of the Society of Automotive Engineers, meeting in Washington. He said, "We have been used to producing 200 or 300 engines per month, where now we need to produce 2,000 to 3,000 per month. In other words we must increase our rate of production approximately 10 times. To most people this increased production rate is merely a matter of applying the well-known production methods of the automobile industry. This naïve statement has just enough truth in it to confuse the minds of many people both inside and outside of the aviation industry. Between the statement and the actual fact the gulf is very wide indeed. It is true that the principles developed by the automobile people in Detroit must be applied to aircraft and engine production, but we are sure that it is equally true that these principles must be modified and further developed to suit the new set of standards and the new tempo required in the aircraft field."

Mr. Hill stated that civil aviation does not require more than a small fraction of the number of planes used for military purposes. "Diverting our design and construction efforts from commercial to military aircraft is relatively easy compared to the main problem confronting us—which is mass production. There was no mass production in aircraft or aircraft engine manufacture before Germany tried it. It is a striking fact that airlines as we know them now do not need many airplanes to carry on a very substantial traffic. The reason for this is that the airplane completes its trip so quickly that many more trips are possible with the same airplane in a given period of time, than with the train, or the automobile. The trip from New York to Chicago, for example, takes 4¼ hours by air. It is obvious that in a 24-hour day three or four one-way trips can be made with only one airplane. It is significant that the largest domestic airline in this country has all told less than 100 airplanes."

"What most people do not realize," Mr. Hill continued, "is that changes in design are made more or less frequently in mass-producing industries, and most frequently in those which produce the best products." Defining mass production as "a carefully organized and highly integrated process of producing, in relatively short periods, large quantities of parts which are all exactly alike," he emphasized that the parts need to be exactly alike only for a desired production interval. "If the parts are made fast enough a definite proportion of the working time can be allocated to changing tools and fixtures to incorporate changes in design on the part. This new technique of producing good aircraft engines in large quantities is, first of all, recognition of the methods which have made it possible to develop successful modern engines and produce them in small quantities. These methods are the application on a grand scale of research, experiment, and proof-testing under constant pressure to produce practical results. Second, use of the very finest materials and manufacturing processes. Third, and most important, provision of flexibility in the manufacturing scheme for continuous absorption of detail improvements as they become available."

DEFERMENT FROM THE DRAFT OF GRADUATE STUDENTS IN SCIENCE, TECHNOLOGY AND EDUCATION

DRAFT boards are urged to give special consideration to deferment of graduate students in scientific, technological and educational schools and students in engineering and health services, in a resolution passed by the New York Branch of the American Association of Scientific Workers.

After July 1, the group deferment of students expires, and local draft boards must consider the continued deferment of each student individually on its own merits. A student in these nationally important fields is put into the deferred classification if the local board finds him a "necessary man."

The Scientific Workers urge local boards to take advantage of information that might be furnished by the National Roster of Scientific and Specialized Personnel and to judge the usefulness of such a student by standards provided in a report made at the request of Dr. C. A. Dykstra, director of the Selective Service System, by the National Academy of Sciences and the Subcommittee on Military Affairs of the National Committee on Education and Defense.

According to this report, defense needs clearly require

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careful consideration of requests for deferment for students in the following fields: Medicine, dentistry and pharmacy; biology, bacteriology and any other branch of biological science which bears directly upon problems of medicine or the public health, safety or interest; chemistry; physics; geology and geophysics, including such specialized fields as meteorology, hydrology and cartography; engineering, including civil, electrical, chemical, mechanical, agricultural, sanitary and mining.

"It is generally recognized," the resolution states, "that American democracy depends upon the welfare of its citizens and that this democracy must be safeguarded by an expansion of economic, social, and physical security. These prime requirements of our freedom in turn depend on the full utilization and expansion of our science and technology, our educational system, and our public health services. Our essential resources and services can be maintained only by assuring continuity in the development and utilization of existing personnel and in the adequate training of new personnel.

"However, the conscription, under the Selective Service Act, of the nation's young men for military training, threatens to create a serious dislocation in the country's welfare by disrupting the continuity of their scientific and technical training and services.

"These activities in specialized fields are so rigorous and require such continuous application to keep abreast of current advances that even a year's absence from their pursuit will cause an enormously disproportionate loss in the effectiveness of the training."

"Such loss means lowering the standards of our specialized personnel and will be reflected for many years in its effect upon the educational and public health services and upon the science and technology of our country.

"One of the primary functions of the administration of the Selective Service Act requires that military personnel be developed with a minimum disruption of those spheres of national activity which are of great social value. It is important, therefore, to protect the continuity of the development of professional and technically trained persons."

The New York Branch of the American Association of Scientific Workers requests information regarding any case in which the decisions of the local draft boards in the case of scientific workers indicate that the drafting of such workers for military service would not be in the best public interest. The New York Headquarters of the Association are at 15 Bank Street.

ITEMS

PATIENTS entered hospitals in the United States at the rate of one for every three and one tenth seconds during the year 1940, according to the latest annual hospital census taken by the American Medical Association. Babies entered hospitals, not by the front door but by the way of the obstetrical department, to the number of 1,214,492. The total number of beds now available in registered hospitals throughout the nation is 1,226,245. This means that just about one out of every hundred persons in the country can be in a hospital at the same time.

THAT grasshoppers will not be as serious a pest during the coming summer as they have been for the past three seasons is indicated by field surveys by U. S. Department of Agriculture entomologists. They will be both fewer in numbers and less wide-spread in area under severe attack. The only large areas shown in black on the grasshopper map comprise the Dakotas and western Minnesota, and western Kansas and parts of adjoining states. There are also smaller threatened spots widely scattered over the West. However, even with the reduction in the menace, something over 45,000 tons in arsenic-poisoned bran-sawdust bait will still be required to hold back the hordes in the threatened areas. Grasshoppers are like weeds, if you let them go unchecked one year they come back at you the next with hundredfold reinforcements.

INVESTIGATORS of the U. S. Bureau of Mines are carefully examining American deposits of tungsten, manganese, nickel, mercury and other strategic metals, with an eye to their use if present overseas sources should be suddenly cut off. Exploratory operations on thirty two sites have been conducted, of which seven have been completed. Dr. R. R. Sayers, director of the Bureau, states that six new ones will be opened up as soon as weather permits. Existence of these ore bodies has long been known, but many of them are too low-grade to be economic under normal conditions. A serious emergency might justify the higher cost of working them. Tin remains the outstanding metal problem, for there is practically none in North America. If we should lose access to overseas sources it would be necessary to rely on accumulated stockpiles and to find substitutes.

COTTON is being grown in blockaded Italy, according to *Die Umschau*, which has just reached this country. Last year's crop was raised on a little under 125,000 acres, and it is planned gradually to increase the acreage to double that figure. Even so, this home-grown cotton can satisfy only about 6 per cent. of Italy's normal needs; yet greater acreage could be devoted to the crop only at the expense of the area now planted in wheat. Italy's present cotton-raising venture repeats the country's experience during the American Civil War, when the supply of American cotton was cut off by the Federal blockade of Southern ports. In 1864, which was peak production year, Italy had well over 200,000 acres in cotton. In subsequent years, interest in cotton production declined to a low of only a little more than 8,000 acres in 1930.

THAT even alligators are in need of protection from over-shooting, is stated by the U. S. Fish and Wildlife Service. The big bull alligators, 12 to 15 feet long, that used to yield hides for large-sized suitcases and other leather goods, are practically never seen any more, even in the deepest recesses of the swamps of the South. Old-time swampmen say there are plenty of five- and six-foot sizes, but no really large ones. However, where the reptiles have received protection, as on government refuges, they are already starting a comeback, and it is hoped that eventually selective hunting (which takes the big ones and leaves the little ones for replacements, will afford the resident hunting population a steady income source. The beginning years will be the hardest, for alligators grow very slowly after they reach about a ten-foot size.

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SCIENCE NEWS

Science Service, Washington, D. C.

FLOW OF ELECTRICAL CURRENTS IN THE ATMOSPHERE

By shooting radio waves up into the higher layers of the atmosphere, and measuring the brief period required for the echo to return, investigators at the Carnegie Institution of Washington are now able to determine the density of the broken atoms that cause these echoes.

There are three layers in the atmosphere, consisting of very rarefied gases which have been "ionized" by ultra-violet rays from the sun knocking outer electrons from the gaseous atoms. The lowest, the E layer, is responsible for most of the bending of radio waves around the earth's curve, which makes possible wireless transmission over long distances. This has a height of about 68 miles. Above are the F-one and F-two layers, with heights of 140 and 218 miles. At night these combine to form one F layer at about 155 miles.

"For the first time by this means," says the announcement, "it is possible to determine what happens to the upper atmosphere with the cyclic variation of spots on the face of the sun, due supposedly to titanic whirlwinds in the solar atmosphere. Between the minimum and the maximum number of sun-spots there is an increase of about 300 per cent. in the density of the electrified particles in the uppermost layer, while there is an increase of about 50 per cent. in the two lower layers.

"Among the problems which it is hoped to solve by the new technique," it is explained by Dr. L. V. Berkner, of the staff of the Carnegie Institution's Department of Terrestrial Magnetism, "is the level of flow of the great electric current-systems in the earth's outer atmosphere. Present indications are that the most suitable conditions for maximum current-flow exist at a level about 70 or 80 kilometers above the earth's surface. Experiments have been suggested but not yet made which should lead to quite precise estimates of electrical conductivity at the several heights."

RADIO FREQUENCIES

SATURDAY, March 29, will be "moving day" for the country's radio broadcasters.

After 3:00 A.M., on that date, most of your favorite stations will come in at a different dial setting from the one they have had for many years.

If you have a set tuned by push-buttons, they will no longer work properly.

For the radio station engineers, it will mean a good deal of work, and a complete change of at least one small but important part.

The result of all this, however, will be greatly improved reception throughout the nation, especially in rural areas.

Through the Federal Communications Commission, the U. S. Government carefully polices the ether. From several monitoring stations in different parts of the nation, they watch all the broadcasters, to make sure that they stay in the band to which they are assigned.

On this account, the stations have taken careful pains to stay where they should be. But beginning on the twenty-ninth, almost all will have to make a change. Only those with present frequencies below 740 kilocycles will be unaffected. In most instances, the shifts will be slight, generally a little higher. In a few, however, the jump will be half way around the dial. A station at 1090 kilocycles, as an example, will go to 1310. On the other hand, one at 760 changes only to 770.

A small crystal of quartz, about as big as a lump of sugar, provides the control of frequency at the transmitter. Such a crystal, carefull selected, precisely cut to size, can be made to vibrate so that it yields exact electrical vibrations of any desired frequency. Such a circuit is used to run some of the most accurate clocks.

But the frequency determines the dimensions of the crystal, and that means that each of the 700 stations which will change must get a new one. It might be imagined that some swaps could be effected. A station now on 1190 kilocycles, that has to move to 1210, might send its crystal to one at 1160, which is changing to 1190. This, unfortunately, is not practicable. The stations are in widely scattered parts of the country. On Friday evening, March 28, they will still be at the old position, with the old crystal still in use. But that evening, you may be sure, they will all have the new equipment ready to change over by the throw of a switch.

The reason for all this trouble is to improve reception, and as a gesture of good will to our southern neighbors, in Central and South America. Present broadcasting assignments were made in 1928. Then there were no big stations south of the border, so small ones in Latin America could operate freely on the same channels as U. S. stations. Now they have big ones. The most powerful station in the western hemisphere is in Mexico City. Its power is 350 kilowatts, seven times the 50 kilowatts maximum allowed in the United States by the F. C. C.

Some of these stations continued to operate on the same frequency as the U. S. stations, but their higher power interfered with them, except within fifty miles or less of the transmitter. Others tried to slide in between two American stations, but this was even worse. Already as close as practicable for them to be, with channel separations of 10 kilocycles, this meant that two U. S. broadcasters were affected.

To remedy this, an international conference was held in Havana in 1937 and new assignments were harmoniously worked out. Now Canada will have six exclusive channels, Mexico six, Cuba one, and the United States more than 40. In addition, certain channels are shared, where distances between stations are enough to prevent interference.

Changing push-button sets to operate on the new frequencies is not a difficult task. The directions that come with such sets tell in detail how to do it, and generally the only tool required is a screwdriver. Mostly, such changes will have to be made after the frequency shift takes place, otherwise you could not set the buttons ac-

curately. And while you are waiting to make the change, you can tune with the dial.—JAMES STOKLEY.

MOLECULES MEASURE TINY SURFACES

IF you wanted to measure the surface area of a floor and you lacked both tape and yardstick, you could still do the job if you had a large enough bag of marbles. And if the surface happened to be uneven and full of waves as in the case of, say, a mud hut, you could probably to a better job with the marbles than with the yardstick.

By simply pouring your marbles out until they covered the whole floor in a layer one marble thick, and then counting the marbles in the layer, you could calculate from their number and from their known diameter the extent of the space they covered.

This is the way Dr. Thomas W. DeWitt, assistant professor of chemistry at Virginia Polytechnic Institute, explains a method known as low-temperature adsorption which he and Dr. P. H. Emmett, head of the department of chemical engineering at the Johns Hopkins University, applied successfully in measuring the surface areas of numerous very finely divided or porous materials used in industry. The "marbles" he uses are molecules of gas.

Some of their results are reported in the Analytical Edition of *Industrial and Engineering Chemistry*. The method was developed by Dr. Emmett and Dr. Stephen Brunauer, but its application to these industrial materials is new, and many an industry processing such materials may derive practical benefit from it.

Commercial clays, pigments and carbon blacks are a few of the substances for which a knowledge of surface areas of the particles is important. There are other ways to measure them, but none provides so direct and simple an approach to the problem as that employed by the authors of the present article in their work at the Johns Hopkins.

THE PHYSICAL FITNESS OF CHILDREN

THE physical fitness of boys and girls between two and twenty years of age can now be reliably and quickly appraised by a new method using height and weight figures. The method, which fills a need felt for over a century by physicians, school and child health authorities and military authorities, was developed by Dr. Norman C. Wetzel, of the School of Medicine of Western Reserve University. Details are presented to physicians in the *Journal* of the American Medical Association.

Efforts to improve the health of American youth, quickened by the spur of national defense preparations, can go forward with increased speed by the use of this method. With more than 40,000,000 boys and girls under twenty years of age in this country, health improvement programs are delayed at the very start by the vast number of examinations that must be made to find all the boys and girls needing better diet or medical care. Dr. Wetzel's grid method for using height and weight measurements alone enables the medical examiner to tell at a glance, the editor of the journal points out, whether a child "is safely situated in a channel where its nutrition can not be seriously questioned or whether it belongs to the abnormal groups."

Tests on several thousand Cleveland school children show the method to be 94 per cent. reliable in picking out the children whom experienced examiners call "poorly nourished" or "borderline."

The method shows any tendencies toward abnormal growth or development at an early stage, when the abnormalities can be most readily corrected. It has the advantage, also, of giving information in an objective way, making it most suitable for large surveys of the physical status of millions of children. Such surveys have heretofore been unsatisfactory because medical examiners have used different indices of physical fitness and there has been no agreement on which was most reliable.

SULFADIAZINE

HOPE that sulfadiazine, one of the newest of the sulfa drugs, may prove the means of preventing as well as curing meningitis appears in a war-censor-delayed report made public in Boston on March 22.

Significant advances toward the control of diphtheria and scarlet fever, as well as meningitis, were made in Halifax, N. S., this winter during epidemics which threatened to slow the steady flow of supplies to Great Britain. The investigation was made by eleven American men and women comprising the Harvard Medical School expedition. Under the leadership of Dr. J. Howard Mueller, this expedition spent four weeks in the disease-ridden city studying these infections and helping local authorities to bring them under control.

The story of the expedition can be told now because the menacing epidemics have been checked; because measures have been taken which make their recurrence unlikely, and because the advances made will be used to strengthen America's defense against disease.

Meningitis was never as rampant in Halifax as was diphtheria, but it was a constant smouldering threat. The new sulfa drug was used by Dr. John H. Dingle, of the Harvard expedition, to control the situation. It appeared "to have certain advantages" over other sulfa drugs used against meningitis and was felt to be especially valuable in solving the important problem of carriers of the disease.

This is because sulfadiazine not only helps the patient to get well but apparently swiftly banishes the meningitis germs from his nose and throat, where they may lurk long after he is well, constituting a hazard to other persons. "The suggestion is obvious," Dr. Mueller reported, "that healthy carriers may be similarly cleared up."

This theory could not be verified experimentally in Halifax, but it has since been confirmed by an Ottawa physician who studied troops in that area. It is an entirely new idea and one completely contrary to the experience of the last war. It is believed that it may be the beginning of the end of the carrier problem in meningitis.

A new and better technic for diagnosing meningitis which has certain advantages making it "particularly suitable for military use under field conditions" was developed through a new culture medium for growing meningitis germs prepared by Dr. Mueller.

A better method for dealing with the problem of protecting adults against diphtheria and more knowledge about scarlet fever, including the discovery of a new strain of scarlet fever germs, are other advances made by the expedition.

The official report is being forwarded to the Surgeon-General of the U. S. Public Health Service so that this nation may profit from the Halifax experience.

SOYBEANS

SOYBEANS, the newest major addition to American farm crops, have been enlisted for the war on weeds by Professor A. L. Bakke, of Iowa State College. The enemy under attack is the European bindweed, alias Creeping Jenny, one of the worst pests with which Midwestern and Western farmers have to contend. It is a species of wild morning-glory that forms dense tangles on the ground and strangles almost any crop that the farmer tries to grow. Bindweed in the field constitutes valid reason for refusal of a loan in many communities.

The first step in Professor Bakke's method of attack is ordinary fall plowing. Then, in early spring, the soil is worked with a duckfoot cultivator, and in June comes a second plowing, burying the bindweed shoots under six or eight inches of soil. After this, the field is leveled off and the soybeans drilled in, thick and solid. Before the buried bindweed shoots can work their way to the surface the beans are up and growing, and they keep the lead all season, never letting the sun get down to the struggling weeds.

Bindweed roots tremendously deep—sometimes 15 or 20 feet into the soil, with great reserve stocks of food in thick tubers. So the treatment has to be kept up until the weed's reserves are all gone—usually a matter of five years. However, the soybeans pay their own way and something over, so that the farmer does not lose money while he is conducting the operations.

An entirely different line of attack on bindweed and other field pests is being conducted, thus far only on an experimental basis, by E. M. Dieffenback, agricultural engineer at the Utah State Agricultural College at Logan. Mr. Dieffenback is trying to develop a means for electrocuting bindweed in the field by discharging electricity into the plant's long rootstocks.

In experiments to date, all rootstocks that took as much as ten milliamperes, at from 150 to 700 volts, were killed. If the method can be put on a practical, large-scale basis, it will probably open a great market for low-priced electric current in areas now being opened up to rural electrification.

One Kansas inventor has recently obtained a patent on a special farm implement designed for fighting bindweed. It is built very much like an ordinary hayrake, but instead of teeth it has several horizontal blades, set at angles to the line of movement, and so arranged as to slice through the ground a little below the surface. While this implement will doubtless give a clean shave to a field heavily bearded with bindweed vines, it will not exterminate them, for their rootstocks go too deep for such superficial treatment. Still, it clears the surface, and should permit quick-growing crops, like soybeans, to get a good start.—FRANK THONE.

ITEMS

CONTINUOUS records of weather run back for a hundred years at only a few stations in the United States, but a study made by the U. S. Weather Bureau of four such records from widely separated stations (Minneapolis-St. Paul, St. Louis, Boston and Washington) indicates quite strongly that since 1830 there has been a tendency for the climate to warm up. During the first third of the century of 1840 to 1939 temperatures at all four stations were prevailingly low. During the second third they showed frequent alternations between below and above normal, and in the past two decades there has been persistent abnormal warmth.

HYBRID corn is now being planted on approximately 25 million acres in the 12 Corn Belt states, according to Dr. R. W. Jugenheimer, of the U. S. Department of Agriculture. This is more than half the corn acreage in those states. In Iowa, where hybrid corn got its first start through the scientific experiments and promotion efforts of Henry Wallace while he was still editor of *Wallace's Farmer*, some 7¾ million acres, constituting 88 per cent. of the state's corn acreage, was planted to hybrid corn in 1940.

GLYCERINE, a chemical important in wartime for the manufacture of explosives, and highly useful in peace as well, can be made from readily available raw materials, such as petroleum refinery gases, by a new process invented by Dr. Richard S. Shutt, of the Battelle Memorial Institute at Columbus. Previously, the 150,000,000 pounds of glycerine which America uses annually for making plastics and other products has come from purified vegetable and animal fats. Using a rare chemical compound as a catalyst to speed the reaction without itself being changed, the Shutt process is said to have many advantages. It produces no undesirable by-products, and high temperature chlorination, common to other methods, is eliminated.

SERIOUS complications and illness may follow operations if talcum powder from the surgeon's gloves gets into the surgical wound. A warning of this danger is given by Dr. Edward J. McCormick and Dr. Thomas L. Ramsey, of Toledo, Ohio, in a report in the forthcoming issue of the *Journal* of the American Medical Association. They report two cases of postoperative complications in which second operations were required, one of them resulting in the loss of the child-bearing organs in a 21-year-old woman. In both cases crystals of magnesium silicate, or talc, were found in the inflamed tissues removed at the second operations. It is probable, the Toledo surgens believe, that many other cases of postoperative complications caused by talcum or by lycopodium powder have gone undiagnosed in the past. Careful washing of the gloved hands of the surgeon and his assistants, to remove the powder used on the gloves, and care to keep the air of the operating room free of the powder are urged to prevent such complications.

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Like previous editions of this widely-used text, the present revision provides a body of principles which may be brought under such topics as morphology, physiology, ecology, taxonomy, geographical distribution, paleontology, and evolution. Greater emphasis has been placed upon function; problems of development are rediscussed in the light of present views; and other important changes and revisions have been made.

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SCIENCE NEWS

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THE STAR BETA LYRAE

IF it could be seen from the proper angle, through some super-telescope many times more powerful than any now contemplated, the star Sheliak would be revealed as a gigantic pinwheel of red, yellow and green gases, spiralling outwards from a double star at the center to a distance of 50,000,000 miles. This star, called Beta Lyrae by astronomers, is in the constellation of Lyra, the lyre, near the bright star Vega, which can now be seen in the northeast about midnight.

The pinwheel conception is given by Dr. Otto Struve, director of the Yerkes Observatory, in a paper in the April issue of the *American Journal of Physics*. His ideas are based on the researches of his colleague, Dr. Gerald P. Kuiper.

Beta Lyrae is normally fairly bright, of the third magnitude, but in 1784 a 20-year-old deaf mute in England, John Goodricke, noticed that it varies in a period of a little less than a week. Later it was found that the star's cycle is really 12 days 22 hours. From its full brightness, after 6.5 days, it decreases about a third, then it returns to the original, and drops again, this time to about two fifths of its former brilliance. Then it brightens again, and the cycle starts over.

Though it was long ago realized that this is a double star, with two parts, revolving around their center, and that sometimes both stars are visible, sometimes one, and sometimes the other, depending on which is in front, many peculiarities were discovered, requiring an elaboration of the theory. Many of these were found in analyzing the star's light through the spectroscope. Now, however, astronomers have evolved what appears to be a satisfactory theory to explain its mystery. Dr. Struve summarizes the conception as follows:

"The star is actually a binary, just as the older theory had predicted. However, the cool and relatively small star which turns around the hot supergiant is so much fainter in light that we can not even photograph it; in the time required to record it, the image of the hot supergiant would be so completely overexposed that the photographic emulsion would be burned out. Of course, the distance of Beta Lyrae is so great that we can not actually see the pinwheel structure of the expanding gases, or the motion of the faint companion around the primary star. Even the greatest telescope now in existence is much too small to bring this marvel to our eyes. We must be content with information secured by theory and indirect observation. Imagine then a giant sun so hot that its color is essentially blue, so large that a good portion of the entire solar system could be hidden within its confines, and so brilliant that our sun would completely disappear in its glare. At a short distance, probably less than the radius of the large star, is another sun, yellow in color, and relatively cool, though hotter and considerably larger than our sun. This yellow star revolves around the blue supergiant once in 13 days. Its gravitational attraction upon the supergiant is tremendous. Tides tend to elongate the latter, until its shape is like that of an egg, and until some of its outer gases coalesce with the gases of the yellow sun. This spiral is hot—almost as hot as the blue supergiant; and the gases shine in all the colors characteristic of electric discharges in gases—luminous hydrogen with its red tinge, helium with yellow and green, neon with its red; the matter spirals out with a speed close to 100 miles per second."

THE SPEED OF LIGHT

LIGHT travels at a speed of 186,272 miles per second, a figure which is probably not more than 8.7 miles per second in error. This new value, about 12 miles per second less than hitherto generally accepted, has been reported by Dr. Wilmer C. Anderson, now with the American Research Company, of Beaumont, Texas. He made the determinations while on the staff of the Cruft Laboratory of Harvard University. This does not, however, mean that the velocity is lessening, for he has included correction for a factor known as "group velocity," which has been assumed to be negligible in previous researches and has been neglected. This might amount in some cases, he says in a paper in the *Journal* of the Optical Society of America, to as much as 4.3 miles per second. He concludes, therefore, "that the velocity of light is a constant as nearly as we can measure it at present."

Dr. Anderson's measures were made with the aid of an electric eye, or photoelectric cell, and used automatic means of recording the data, eliminating, to a great extent, errors of human measurement. Fundamentally, this was the method used. An electric current vibrating 19,200,000 times a second controlled a Kerr cell, which is a form of light valve, and produced a beam of light with the same number of variations per second. This beam, therefore, was made up of sections of light a few feet long, alternated with dark spaces of the same length. By a mirror with a very thin coating of silver, this beam was divided into two. One part was sent to a near-by mirror and back, the other part traveled over a much longer path before it was sent back, and the two recombined, to fall on the electric eye.

If the two parts of the beam are joined so that the bright and dark portions are exactly in step, then the light falling on the electric eye varies just like the original beam, and there is a maximum electric current from it. Now, if the near-by mirror is moved, the path of the first part of the light beam may be increased by just the length of one of the bright sections. Then, when the two parts of the beam are brought together again, the dark part of one will coincide with the bright part of the other. The resultant beam will then be steady, and no current will come from the electric eye. From the difference in the light paths when this minimum value of the current is reached, the speed of the light may be calculated.

Elaborating greatly on this fundamental method, Dr. Anderson and his associates made 2,895 measurements. These give the speed of light as 299,776 kilometers (187,272 miles) per second. This may be in error as much as 14 kilometers (8.7 miles) per second. The chief source

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of error remaining is one that involves the electrons in the electric eye which watches the changing light beam. The electrons which are shot out from the sensitive surface of the photoelectric cell where the two parts of the beam strike, have to travel a slightly different distance, and this prevents the most accurate measurement of the times when the beams are in and out of step. This problem, he says, will have to be solved before the accuracy of the method may be increased.

THE NUMBER OF DEFECTIVES IN THE UNITED STATES

FREDERICK OSBORN, chairman of the Joint Army and Navy Committee on Welfare and Recreation, speaking before the recent meeting of the American Eugenics Society stated that the first contribution of eugenics to national defense should be reducing the number of defectives in the United States.

"The public should insist that doctors and public health authorities get to work at reducing the number of defectives," Mr. Osborn said. He pointed out that two or three million people in the United States are so seriously defective in mind and body that they are a tragic burden to themselves, their families and their communities. Declaring the majority of these defects hereditary, and quoting Justice Holmes's statement, that three generations of feebleminded are enough, he said that conservative methods, generally approved by the public, can lessen numbers of these defectives born in this country. These methods are "registration, segregation and refusal of marriage license to the feebleminded; use of contraceptives under medical advice by mentally normal carriers of defect; extensive search for bad family strains."

Even more important for national defense, he added, is the second contribution of eugenics—to encourage abler stocks of people in every section of the country and every social class, rich or poor, to have more children than their irresponsible neighbors.

Denouncing dictator tactics of arbitrarily controlling births as not eugenics at all, Mr. Osborn said: "The right to have or not to have children must be safeguarded in a democracy, along with the right to freedom of speech and freedom of worship." He emphasized that a democracy must provide social conditions to enable abler stocks to have good-sized families, and these able people must contribute the material for leadership.

THE NEW REGIONAL LABORATORIES OF U. S. DEPARTMENT OF AGRICULTURE

THE four new regional laboratories of the U. S. Department of Agriculture, now just getting into action, will permit larger-scale experimentation than has been possible in the past, according to a report made by Dr. Henry G. Knight, chief of the Bureau of Agricultural Chemistry and Engineering, at the Seventh Annual Chemurgic Conference.

About a third of each of the million-dollar buildings will be devoted to pilot-plant operations, that is, experiments using equipment only a little less than full factory size instead of the small flasks and test-tubes of the ordinary laboratory. Pilot plants enable manufacturers to get an idea of how profitable an operation that is known to be theoretically possible may be.

These laboratories at Philadelphia, New Orleans, Peoria and near San Francisco, to work on typical agricultural products of East, South, North and West, respectively, will be staffed by about a thousand men and women, including some of the most successful chemists the country has produced.

Dr. Knight pointed out that "It is a comforting thought to know that these laboratories could be turned into research institutions for national defense should the occasion demand. If we should lose the freedom of the seas and be cut off from the rest of the world our export trade would probably drop below the low mark where it now stands. It is reasonable to assume that such a situation would further increase the surplus problem and make it necessary for us to create in this country, if possible, greatly expanded markets for many of our major farm crops. That's the object of the laboratory program."

THE CONTROL OF CANCER

PERIODIC physical examinations, urged by the American Society for the Control of Cancer as a means of detecting early cancer, can be obtained for from 50 cents, or even nothing, to $5, the latter for persons with incomes of $5,000 or more. These fees apply in New York City, where "there are excellent facilities for men and women to get themselves examined for cancer and be treated at modest fees." The question was one of a number submitted by the National Association of Science Writers to the American Society for the Control of Cancer.

Outside of New York City facilities for cancer diagnosis and treatment seem to vary widely. Information from the survey was summed up as follows: "On the question of indigents, states vary widely in their handling of these patients, some of them depend on County Commissioners, on social agencies, or on welfare boards, others rely on state appropriations for cancer control. The physician-spokesmen felt that examinations and medical treatment could be had by those seeking it. In certain large western and southern states, those in rural areas seem less well cared for than those in cities. In several areas, it was not possible to secure long hospitalization for indigent patients for whom there was no hope of cure."

Standard fees for examination and diagnosis can be set, as they are in New York City, on the basis of the patient's income. Fees for treatment can not be standardized. This was explained as follows:

"It was agreed that physicians by and large carefully fit their fees to the patient's income and ability to pay. The problem of a standardized fee for treatment is very difficult since the individual cases vary so widely and require such different types of treatment. Cancer, it must be remembered, is not one disease but many, and the prognosis and treatment of cancer of the stomach, for instance, is entirely different from cancer of the breast; cancer of the skin and cancer of the bone are unlike in so many ways as to make it impossible to set a blanket fee for their care."

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LIFE-SAVING OXYGEN SHIRT

A LIFE-SAVING "oxygen shirt" to aid life guards in rescuing drowning persons is announced by Dr. Christian J. Lambertsen, of the University of Pennsylvania Medical School, in the *Journal* of the American Medical Association. With this apparatus strapped like a harness to his back and chest, the life guard will be able to stay under water for from 18 to 25 minutes in depths to 60 feet while searching for drowning accident victims, instead of the usual one minute at depths to 30 feet.

The oxygen harness which thus increases the life guard's life-saving ability weighs just over 12 pounds in air. Under water it is practically weightless. A small cylinder for oxygen or an oxygen-nitrogen mixture fits into a pocket. A nose and mouth mask, rebreathing bags, lead plate and a soda lime container are the other chief features. The breathing bags, breathing tubes and inhaler are all buoyant under water and their lift almost exactly balances the under-water weight of the oxygen cylinder, regulator, soda lime container and the lead plate. The apparatus can be strapped on and be in use within 15 seconds or less. It is designed to fit persons of varied size and shape without time-consuming adjustments. Unlike the deep-sea diver's outfit, this apparatus does not require an assistant at the surface but it does not give protection against cold while under the water.

Besides helping life guards and others to rescue drowning persons, the apparatus could be used for inspection and minor under-water repairs of hulls of boats; for pearl and sponge fishing; sport, as in goggle fishing; and, with slight modifications, in mines, sewers, chemical plants and gas companies where the atmosphere is deficient in oxygen or contains noxious gases.

ITEMS

WILD ducks have responded amazingly to the opportunities offered by new refuges, according to the U. S. Fish and Wildlife Service. A census of one Southern refuge, on the White River in Arkansas, shows a population of about a million and a half ducks, mainly mallards, and other species wintering there. Growth of food plants that ducks like is being encouraged, to meet the increasing demands. Observers have noted an increase in the number of Canada geese wintering on the White River Refuge this year. D. N. Graves, director of the Arkansas Fish and Game Commission, reports that "The increase in the number of geese in Arkansas this year is remarkable, and the ducks have also increased substantially. It is evident that the Fish and Wildlife Service refuge program is bearing fruit. I have seen more ducks on the White River this year than I have ever seen in my life."

ON a recent cruise to the Gulf of California by the E. W. Scripps, research vessel, a core of diatomaceous mud nearly 17 feet long was hauled up from the bottom, an all-time record. Until the present time the longest core of mud has been about 10 feet, according to Dr. Roger Revelle, of the institute. He stated that the new record was established because of two factors: first because the diatomaceous mud in the Gulf of California is extremely soft, and second because important improvements have been made on the coring equipment. It was designed by R. S. Dietz and K. O. Emery, graduate students of the University of Illinois, who have spent two years at La Jolla. The coring equipment consists of a long barrel, 20 feet long and 2½ inches in diameter. The lower opening is slightly smaller than the barrel, and the barrel itself is lined with celluloid, both factors being important in reducing friction. The equipment is lowered to the ocean floor by cable and the force of gravity drives it into the mud.

THE fossilized comb of a wasp nest whose inhabitants might have stung the last of the dinosaurs has been added to the collections of the Smithsonian Institution. It was found in southwestern Utah by Dr. J. B. Reeside, Jr., and Dr. C. E. Dobbin, of the U. S. Geological Survey, and has been described in the *American Journal of Science* by Dr. Roland W. Brown, also of the survey. It dates from the last Cretaceous, last phase of the dinosaur age, about 80 million years ago. Wasps, according to Dr. Brown, apparently preceded their relatives, the bees, into the world, and pioneered in the transfer of pollen among flowering plants.

THE power of 40,000 horses will be yielded by a single motor just completed at the Westinghouse works in East Pittsburgh. Largest of its kind, the motor will drive air as fast as 400 miles per hour through the Air Corps' new plane-testing wind tunnel at the Wright Field, Dayton, Ohio. It is expected to be completed and ready for testing full-sized plane propeller and engine enclosures by July 1. The motor will turn two fans, each as tall as a four-story building, and with 16 blades. The frame of the motor is so big that a small truck could be driven through when the 50-ton motor is removed. Despite its size, explained C. M. Laffoon, engineer of the Westinghouse Company, the speed can be varied from 37 to 297 revolutions per minute. Ordinarily the speed of such an induction motor would be regulated by rheostats and resistances through which excess power would be used up as heat when operating at reduced speeds.

Two electrical generators at Grand Coulee Dam, Washington, are now in operataion, producing for the first time power from the water of the Columbia River impounded behind this dam, mightiest man-made masonry structure in history. These Westinghouse generators, each weighing 88 tons, 13 feet high and delivering 10,000 kilowatts of electrical energy, are pygmies compared with the three main generators which will be in use by next summer. These, the largest ever constructed, are also being built by Westinghouse, and will be 24 feet high and 45 feet in diameter. Each will yield 108,000 kilowatts, and the trio would be capable of lighting New York and Chicago combined. Eventually there will be a total of 21 generators here, eighteen of 108,000 kilowatt rating, and three of 10,000 kilowatts, like the two just started. The small generators are now feeding a line connecting the Grand Coulee and Bonneville Dams, so the power they produce will supplement that from Bonneville, supplied to important defense industries. When the big generators are in use, the small ones will supply power for the station itself.

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SCIENCE NEWS

Science Service, Washington, D. C.

WHITE BLOOD CELLS

ALCOHOLIC ingredients for a cocktail that may give white blood cells a "lift" sufficient to fight off invading disease germs have been isolated from bone marrow, was announced by Dr. Harry N. Holmes, of Oberlin College, president-elect of the American Chemical Society, at the St. Louis meeting.

The two ingredients are batyl and chimyl alcohols. Until Dr. Holmes and associates, Dr. Ruth E. Corbet, Dr. Walton B. Geiger, Dr. Wyvona B. Alexander and Nathan Kornblum, isolated them in pure form from bone marrow, these alcohols were not known to exist except in marine animal life. These alcohols were obtained from the part of bone marrow which is effective in counteracting the serious disease, agranulocytosis.

"Agranulocytosis, or leucopenia, is a disease in which the patient lacks the ability to increase rapidly the number of white cells, or phagocytes, during the onset of an infectious disease," Dr. Holmes explained. "These phagocytes fight infection, so nature tries to increase them when menaced with danger. During an acute attack of appendicitis the normal white blood count of about 8,000 may be doubled for the attack on the invaders." Preliminary tests on rabbits with the two alcohols from bone marrow show that they have a definite influence on the formation of white blood cells and may be useful in strengthening the defenses of the body.

Dr. Holmes said that "Dr. Roy Kracke, of the Medical School of Emory University, a few years ago showed that use of certain types of sedatives weakened the emergency mechanism of the human body by which white cells are increased during infection and often lowered the normal white blood count. This looked like fifth column work in the blood. Agranulocytic victims might be swept away by an infection that normal persons could readily combat with their plentiful phagocytes. Such cases are not common but plenty of people have a low white blood count from one reason or another and they might welcome a bone marrow stimulant. Many people have certain unpleasant reactions to sulfanilamide and medicines of that type. Among these reactions is a drop in the number of phagocytes in the blood. Patients treated too long by x-rays also show a very low white blood count and need help.

"Since the phagocytes are made and matured in the yellow bone marrow it is evident that some chemical substance found there is responsible for this necessay manufacture of white cells for the blood. Bone marrow itself is not an article of commerce, so if the medical profession is to have the use of aids in increasing the white blood count during emergencies, it is obvious that pure chemicals must be isolated from marrow, tested on animals, their chemical structure determined and their synthesis accomplished."—JANE STAFFORD.

THE TREATMENT OF INFLUENZAL MENINGITIS

SAVING of 30 out of 43 child lives doomed otherwise to almost certain death from influenzal meningitis was achieved by a treatment reported by Dr. Michael Heidelberger and Dr. Hattie E. Alexander, of Columbia University Medical School, and Dr. William E. Bunney, Dr. Tillman D. Gerlough and Dr. John W. Palmer, of E. R. Squibb and Sons, New Brunswick, N. J., at the St. Louis meeting. It was pointed out that chemical methods used in preparing the antiserum for this treatment can be applied to health improvement for national defense. Experience with these methods has already led to production of a triple vaccine against typhoid fever, tetanus (lockjaw) and diphtheria, which has shown protective value in animal tests. If trials on human beings confirm these findings, it will be possible, with a single "shot in the arm," to give a soldier, or a civilian population in times of disaster, protection against these three serious diseases.

Influenzal meningitis, for which the treatment was said to be the most successful yet developed, is not due to the virus that causes influenza, but to another kind of germ, called *Haemophilus influenzae*, type B. The disease attacks small children chiefly and is rare both in adults and in children over eight years of age. It is highly fatal. Before the new treatment was instituted, the mortality rate at the Babies' Hospital, New York City, was a hundred per cent.

Antiserum, such as was used in the treatment described, is made by injecting the germ of a disease into the veins of a horse or, more recently, of a rabbit. The animal responds by the production of a specific chemical substance in the blood, which is called an antibody.

The active agents in the antisera used for treatment are now known to be circulating proteins modified under the stimulus of the bacterial vaccine or other agent used in producing serum in animals. Analytical chemical micro-methods for picking out these active curative agents from the other inert matter of the serum and actually weighing the amount present, instead of depending on vague relative methods, have not only resulted in a great extension of knowledge regarding the creative antibodies, but have supplied a valuable means of checking the value of alternative methods of immunization and so producing stronger and more efficient antisera and deciding which species of animal produces the best sera.

When these sera are available, the same methods aid in purification and separation of the antibodies, so that the reactions and inconveniences resulting from their use may be minimized. If the antibodies have not been damaged in purification the same analytical methods provide a quicker, cheaper and more humane index of potency than, for instance, the testing of antibodies in mice.

These methods were used to prepare the rabbit antisera and purified rabbit antibody which, used along with sulfanilamide, turned the one hundred per cent. influenzal meningitis death rate into an approximately seventy per cent. recovery rate.

THE COST OF SMOKE

ACTUAL cost each year to people in the United States on account of smoke is $2,500,000,000, and in addition there is the incalculable cost to health, according to a

ANNOUNCING

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THE PLANT WORLD

HARRY J. FULLER
University of Illinois

The Plant World will be published early in May. It is particularly valuable for those students who are interested in botany as a part of general education.

Those aspects of plant life involved in everyday experiences and directly or indirectly concerned with human living are treated in detail. Emphasis is laid upon the economic uses of various plant groups, the formation and germination of seeds, soil fertilization, erosion control, plant diseases, plant hormones, and wood structure.

In ***The Plant World*** brevity is achieved through major concentration upon the biology of flowering plants. Life-histories and morphology of minor groups (horse-tails, club mosses, etc.) are omitted from consideration, but groups of great economic importance, and significance in nature cycles (algae and fungi) are treated in detail. A lengthy section on ecology studies the factors influencing plant distribution, nature cycles, plant communities, plant succession, formation of plants, and the major vegetation areas of North America.

The Plant World is illustrated with many new drawings, and a large number of sharp and striking photographs. Two beautiful color plates are also included. Typographically, the book is both pleasing and arresting.

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Henry Holt and Co., 257 Fourth Avenue, New York

report to the society by W. L. Jones and Dr. F. E. Vandeveer. Dr. Vandeveer is connected with the American Gas Association Testing Laboratories at Cleveland, while Mr. Jones is with the St. Louis County Gas Company. The wastage of coal, gas and oil fuels, due to the incomplete combustion which causes smoke, amounts to $200,000,000. In addition, the extra cleaning of buildings, and laundering or dry cleaning of wearing apparel and house furnishings, and their shortened life, account for the remainder of the total.

"Probably the worst aspect of smoke is its effect on health," according to the authors. "While this relationship is difficult to evaluate, correlation of smoke and high incidence of pneumonia seems to have been clearly established. Much evidence exists that death rates from pneumonia and other respiratory ailments are greater in smoky industrial centers than in small urban communities. The effect of smoke in depriving people of sunlight is another broad aspect of the smoke problem, and one which probably has an important bearing on health."

Wider use of gas as a fuel to overcome smoke troubles, because it can be burned more efficiently and completely than some other fuels, was advocated.

A process that will remove the smoke-forming tar from coal at temperatures of 700 and 800 degrees Fahrenheit, considerably lower than those required in the expensive plants used for making blast furnace coke, was described by C. E. Lesher, president of the Pittsburgh Coal Carbonization Company. At these temperatures, he said, the coal is heated just enough to melt it and to drive off the tar vapors.

When the coal is melted, he said, it becomes plastic. Even though it was originally a powder, it then is sticky, and forms into a soft mass at the same time that the vapors and a part of the gas are given off. This is done in a revolving steel drum. The mass is broken into small pieces, rolled into balls, which quickly harden into dense uniform pieces of low-temperature coke. He pointed out that "This kind of coke has important advantages as a domestic fuel because of its reactivity, which means that it is easy to ignite, and, when it has been ignited, it does not go out in either the fireplace, the stove, or the furnace. It is reactive and easy to ignite because there is sufficient volatile matter left in the product to make it burn readily."

Tar products valuable for making light, strong plastics, which may prove useful for airplane and automobile bodies and free aluminum and other metals for defense needs, can be obtained in the process of making low-temperature coke, said Caleb Davies, Jr., vice-president of the company. More tar is made when the coal is heated to these lower temperatures, and it is different, he said. Also, it can be made more cheaply than in the high-temperature coke ovens. "These new tars obtained from low-temperature carbonization are offering to the chemical industry more abundant supplies of some of the very valuable coal tar by-products, most important of which are probably the tar acids. These tar acids are the higher phenols or cresylic acids that are one of the important raw materials in the rapidly growing plastics industry. Where mechanical strength and lightness of material is required in the plastic, as in the future automobile body or airplane fuselage, the plastic from coal tar phenols is, so far as is known, the most important raw material."

He said that the coal tar industry takes 300,000,000 gallons of tar every year, from which it makes road surfacing materials, creosote distillates for wood preserving, roofing pitch, and a long list of specialties used in the chemical industry.—JAMES STOKLEY.

UNDERGROUND GAS AND OIL FIELDS

BY freezing gases sucked out of samples of soils, to detect hydrocarbons present in the proportion of a few parts in a billion, it is possible to locate accurately underground deposits of oil and gas. Speaking before the American Chemical Society, Leo Horvitz, of "Subterrex by Geophysics and Geochemistry," Houston, Texas, described these new methods. Geophysical prospecting, in use for the past twenty years, he said, can detect salt domes and other subterranean structures which are often associated with oil and gas, but the geochemical process detects the presence of the petroleum itself. "The principle upon which these methods are based," he explained, "is that minute quantities of hydrocarbons migrate from oil and gas deposits to the surface of the earth and that the formations encountered retain some of these leading hydrocarbons."

Soil samples are collected from a 12-foot depth over the area to be studied. They are heated under reduced air pressure. This drives out the gases, which are passed through traps cooled to very low temperatures. For instance, at 204 degrees below zero Fahrenheit, pentane and the heavier hydrocarbons are frozen, but the lighter ones get through. Then the gases are subjected to temperatures as low as 278 degrees below zero Fahrenheit and the ethane, butane and propane will be frozen out. Then a still lower temperature, 300 degrees below zero Fahrenheit, will freeze out the methane. In this way, the concentration of the gases, in parts per billion by weight, are determined, and plotted on a map of the region.

"Considerable investigation," said Mr. Horwitz, "indicates that the hydrocarbons leak principally from the edges of the deposit rather than from the center. As a result, it has been found that the significant hydrocarbon distribution pattern is that in which a zone of low hydrocarbon values is surrounded by a band of higher concentrations. This area of low concentration usually coincides closely with the areal extent of the oil field. The order of magnitude of the values in the band of higher concentrations is usually above 10 parts per billion and the average of these high values is usually more than three times that of the values in the low zone.

"A second geochemical technique has developed which involves the analysis of formation cuttings collected during the drilling of wells. By measuring the contents of hydrocarbons and other constituents in these samples, it it possible to predict in advance of the drill whether a petroleum accumulation will be encountered. In the case of a dry well, the values are very small throughout, while, in the case of a producing well, the hydrocarbons show

increasing values as the deposit is approached. From a study of the relative distribution of the various types of hydrocarbons present, it is possible to predict whether the accumulation will consist of gas or oil."

This method has already assisted in the discovery of several new oil and gas fields and has aided in determining the probable limits of production in other newly discovered fields.—JAMES STOKLEY.

ITEMS

STUDY of the inheritance of physical defects and tendency to diseases in human beings will be undertaken at the University of Michigan, as the result of the establishment of a department of human heredity in the laboratory of vertebrate genetics, and of a heredity clinic to be housed in the hospital of the university. The new department and clinic will be closely associated with the medical school. Although one or two clinics of this kind have been established in Europe, none has hitherto been established in this country. Among the subjects selected for special attention are hereditary dental abnormalities, body proportions and growth, speech defects and deafness.

A GREAT iron meteorite weighing nearly a ton, found by a plowboy in a Georgia field, has been brought to the Smithsonian Institution for study and display in the U. S. National Museum. It is the second largest object of its kind ever found east of the Mississippi. The meteorite, which was buried about two feet deep in the red soil of a cotton field, was struck by the blade of the plow. Since the soil of this particular part of Georgia is almost entirely free from rocks, the boy's curiosity led him to dig down to the obstruction. He managed to break off a small piece, which was eventually sent to the Smithsonian Institution for identification. A visit to the locality by E. P. Henderson, of the staff, and C. W. Cooke, of the U. S. Geological Survey, followed, and arrangements were made for the transfer of the meteorite to Washington.

DESTRUCTION, scattering and isolation, brought by war to the principal scientific collections of the Old World, enhance the importance of similar collections in American museums and universities. The 17 million specimens in the natural history collections of the Smithsonian Institution, comprising everything from pressed wildflowers to human skulls, take on increased significance as scholars become unable to travel abroad in normal fashion. When a new species of plant or animal is discovered, a representative specimen is deposited—usually the first specimen collected—in one of the larger museums. This is known as the type specimen. It is used for comparison with other specimens collected later, to make absolutely certain of their identity. Many of the type specimens in Old World collections have already been destroyed; others have been removed and hidden in safe places. But even where they have thus escaped destruction, they are not at present available for study. Furthermore, practically all important collections in continental Europe are out of reach of Americans and British, as the collections in Britain and America are unavailable to continental scholars.

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Like previous editions of this widely-used standard text, the present revision provides a body of principles which may be brought under such topics as morphology, physiology, ecology, taxonomy, geographical distribution, paleontology, and evolution. It represents the so-called "principles" course rather than the "types" course.

In revising the text greater emphasis has been placed upon function, in order to cultivate the student's interest in the workings of the living machine. To this end descriptions of the mechanism of regulation have been scattered through the physiological parts of the book, and the account of the operation of the autonomic nervous system has been extended. Problems of development are rediscussed in the light of present views, but the rest of the embryology chapter has been simplified. Other changes relating to physiology involve the present concept of the nerve impulse, the chemistry of muscle contraction, the composition of the blood, and the chemists' idea of atomic structure.

FIELD GEOLOGY. *New fourth edition*

By FREDERIC H. LAHEE, Chief Geologist of the Sun Oil Company; formerly of Massachusetts Institute of Technology. 835 pages, 5 x 7¼. $5.00

The new fourth edition of this well-known field manual is a thorough revision to cover recent extensive advances in methods of geological exploration and mapping, particularly those which have been developed to meet the needs of the petroleum industry.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE SUPPLY OF VITAMINS AND HORMONES

THAT there should be no shortage of vitamin A during the present emergency was stated by Kenneth Hickman and Graham C. Mees, of Distillation Products, Inc., at a national defense session at the St. Louis meeting of the American Chemical Society.

Vitamin A is needed for normal growth in children and for good health by people of all ages. It is found in cod and other fish liver oils, and butter and the yellow vegetables such as carrots are good food sources. "The total quantity available in the United States is more than sufficient for all purposes but certain sources are too weak for direct application or for profitable concentration. Most of the vitamin A in the weaker sources, such as palm oil and fish body oils (sardine, menhaden, salmon, etc.) is destroyed because these oils are used industrially without the vitamin being extracted. In the present national emergency, which may be intensified by shipping vitamin products abroad, these weaker sources can be utilized."

Flavor, price and lack of machinery for concentration were mentioned as possible limitations to obtaining vitamin A from these weaker sources. Expansion is now under way in machinery for one process, high vacuum distillation, which will enable the vitamin to be extracted from the weaker oils before the residue is put to industrial uses.

Commercial preparation and clinical use of certain highly important chemicals produced in the cortex or rind of the tiny adrenal glands of the body need improvement as a national defense measure, it appears from a report by Dr. E. C. Kendall, of the Mayo Clinic.

One of these chemicals in particular, known as compound E, has a "remarkable influence on the resistance to shock and toxic substances," Dr. Kendall pointed out. It also has an effect on the capacity of muscle for work.

Any use it might have in treating shock due to war wounds, however, or for other medical purposes is limited by the fact that the total annual supply of this and another important adrenal gland chemical in the United States, derived from animal glands, could not be greater than about one pound.

The other chemical is called compound F for short. These two should not be confused with vitamins bearing the same letters for names. Both these adrenal gland chemicals have "a striking effect upon the enzymes involved in the conversion of proteins to glucose."

The effects achieved by compounds E and F are not achieved by another chemical from the adrenal gland cortex, desoxycorticosterone acetate, which has been used in recent years to keep alive patients suffering from Addison's disease, the once-fatal ailment characterized by a strange bronze discoloration of the skin.

To make these other compounds available for the many uses they may have in war and peace time medicine, chemists must produce them synthetically. Dr. Kendall said synthetic production is the only possible solution to the problem of the shortage of compound E.

CHEMICAL TESTS FOR VITAMINS

AT the American Chemical Society meeting in St. Louis, Dr. E. M. Nelson, of the U. S. Food and Drug Administration, made an appeal to chemists for help in national defense on the nutrition front by developing accurate chemical tests for vitamins. Later, two such tests were announced.

One is for determining the amount of nicotinic acid, the anti-pellagra vitamin which is being put into the new enriched bread and flour. This test was developed by Dr. Bernard L. Oser, Daniel Melnick and Louis Siegel, of the Food Research Laboratories, Inc., Long Island City, N. Y. It is said to measure accurately the nicotinic acid content of both natural and fortified breads and flours.

The other test is for the combined determination of the amounts of the thiamin or vitamin B_1, and riboflavin. Thiamin is a "must" ingredient for the new enriched breads and flours and riboflavin is an optional ingredient. The new method for determining the amounts of these two ingredients in wheat and corn was developed by R. T. Conner and G. Straub, of the General Foods Central Research Laboratories, Hoboken, N. J.

Tests for vitamins heretofore have been made by feeding the test materials to animals and observing their reactions to the diet. Such feeding tests were time-consuming and in other ways less satisfactory than chemical tests. Tests for the amounts of vitamins in foods such as the new enriched bread and flour are needed because even though the correct amounts are added to the flour or the dough, some might be destroyed or otherwise lost by the time the flour was made into dough and the dough baked into bread. Both baking and milling industries and law enforcement officials need quick chemical tests for detecting any losses of this type that might occur.

The combined test for vitamin and riboflavin in wheat and corn show that variety, locality, soil and environmental conditions during growth have a marked effect on the vitamin content of these grains.

A NEW TYPE OF FLOUR

PEELING the indigestible, corky outer coat off wheat grains by means of the flotation process, invented primarily for use in processing metal ores, is the newest development in the bread revolution now actively going on in the milling and baking industries.

The new process is the discovery of a Los Angeles mining engineer, Theodore Earle, who is in Washington at present. By removing only the corky epidermis, it is claimed, the grain can be left in condition to produce a high-vitamin, high-mineral, high-protein flour without sacrificing the smooth texture and agreeable color which most people find attractive in white flour. The new flour is not snow-white, but has what its enthusiasts describe as a "rich, golden tint." Furthermore, they declare,

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it is not necessary to put back into it the minerals and vitamins that are now being added to white flour by the new "enriching" processes coming into practice in the milling and baking industry. The natural minerals and vitamins are simply left in to begin with.

The part of the wheat grain removed in the Earle process is its outermost covering layer, or epidermis. This layer, only a few cells thick, is tough, flavorless, and completely indigestible. Millers nickname this part of the grain "bee wings." Beneath it are several other layers, composing the remainder of the bran coat, including the innermost, protein-rich layer known as the aleurone layer. It is the removal of this layer in the ordinary bolting process that has raised most of the objections to present-day white flour. The Earle process removes the worthless epidermis and leaves the valuable parts of the bran still clinging to the starch-and-glutin mass that makes up most of the wheat grain.

Mr. Earle discovered the basis of his new process quite by accident. His hobby is gardening, especially raising choice shrubs and other plants from seed. He also distributes seed to garden-loving friends. Once, when he was trying a modification of the familiar flotation process to separate good seeds from worthless ones, he was interrupted by a long telephone call. When he returned to his flotation apparatus he found that his seeds had been peeled. He then tried the flotation process on wheat. In the flotation process as applied to mining, finely ground ores are dumped into water containing a small quantity of pine oil or other chemical, which is whipped up into a sudsy foam. This foam contains the valuable bits of metal; the dross settles to the bottom and is discarded. As applied to wheat, the flotation process floats the flakes of worthless epidermis to the surface in the foam and permits the sound wheat grains to sink. To speed up the process, the grains are thrown about violently in rubber-lined containers before they are put into the flotation cells. This just cracks the tough outer layer but does not break the grains themselves. As it comes from the flotation cells the grain is thoroughly wet, and must of course be dried before it can be milled into flour. Since no present milling procedure deals with wet grain at all, it was necessary to adapt a pea drier when large-scale experiments in milling were begun.

The Continental Baking Company has become interested in Mr. Earle's invention. This firm has refitted a shut-down flour mill in Kansas City for the production of flour by the new process, and now has a production capacity of a thousand barrels a day.

It is claimed on behalf of the new flour that it will keep well—one lot remained on hand nine months without spoiling, according to Mr. Earle. He also states that the new flour can be marketed at no advance in price over the standard kinds now available.—FRANK THONE.

A THERMAL DIFFUSION SEPARATOR

A TOWERING instrument 14 feet high, in the General Electric Research Laboratory, at Schenectady, N.Y., may prove the forerunner of the equipment with which science will one day separate power-producing atoms in sizable quantities.

The device is a "thermal diffusion apparatus." It is used in the separation of isotopes, which are forms of the same chemical element of different atomic weight. It was once thought that all atoms of the gas chlorine, for instance, weighed the same—about thirty-five and a half times that of the hydrogen atom.

During the past quarter of a century researches have shown that chlorine, like most elements, really consists of atoms of different weights. About three quarters of the ordinary chlorine atoms are of weight 35, one quarter of weight 37, while there are a very few of weight 39.

At the University of Munich, K. Clusius and G. Dickel a few years ago devised the thermal diffusion method, which has proved to be one of the most efficient methods for separating the different forms, or "isotopes," of the elements. With it, they have separated not only the isotopes of chlorine, but those of neon, krypton and others.

Potentially of great importance is the fact that the same method may be used to separate the 235 isotope from the heavy element uranium. This isotope is the one that may prove capable of yielding practicable atomic power, as it is estimated that a pound of U-235 would provide several million times as much energy as a pound of coal. More than a year ago, investigators in the General Electric Laboratories, as well as at the University of Minnesota, succeeded in securing exceedingly minute amounts of the isotope by another method, but not enough to test its power-producing capabilities.

The thermal diffusion separator at Schenectady consists of two glass tubes, 14 feet long, one inside the other, and a gold wire extending from top to bottom in the inner tube. It contains, in gaseous form, the material to be separated, which is kept at a fixed temperature by passing steam through the outer tube. When the gold wire is heated, the lighter atoms go to the top and the heavier atoms to the bottom where they are collected. A gold wire is used because a baser metal might be consumed or attacked by the material being studied.

For separating uranium isotopes, a material other than glass would have to be used, since the only gaseous compound of uranium is uranium hexafluoride. Because of the fluorine in it, this gas attacks glass. If the tubes also were made of gold, they would not be affected.

A GLARE-ELIMINATING SCREEN FOR AUTOMOBILES

(Copyright, 1941, by Science Service)

A NEW type of glare-eliminating screen for automobiles and other purposes, claimed to be 99.99 per cent. efficient, has just been patented by Edwin H. Land, president of the Polaroid Corporation. It is the first to use invisible, submicroscopic molecules instead of crystals to line up light waves so that they all vibrate in the same direction, and can be partly or wholly cut off by another sheet of the same material set at an angle to the first. It is also the first to be made of wholly synthetic materials, all obtainable in the United States.

Previous polarizers, used in sun glasses, lamps, etc., have employed minute crystals (usually of quinine) embedded in a plastic sheet. The new one, known as Type H,

Published in April

DANA'S MANUAL OF MINERALOGY

FIFTEENTH EDITION

Revised by **CORNELIUS S. HURLBUT, JR.,**
Associate Professor of Mineralogy, Harvard University

For nearly a century a famous and widely-used textbook—Now revised and brought into line with modern theory and practice—

This book is designed specifically for the elementary course for undergraduates. The subject matter has been carefully restricted so that the student will not become confused by the inclusion of material he cannot be expected to know. Much of the book has been rewritten. However, its scope is unchanged, and it is still intended to meet the needs of beginning students and those who wish a concise, accurate, not-too-technical introduction to the study of mineralogy. For greater legibility and more modern appearance, the format has been enlarged. Instead of the flexible binding, the book now has stiff cloth covers.

Part I on Crystallography has been thoroughly revised. The most generally accepted names for the thirty-two crystal classes are given, and a brief treatment of twinned crystals is included.

The classification of minerals has been rearranged in accordance with the form to be used in the forthcoming revision of Dana's "System of Mineralogy." The descriptions of individual minerals are presented in a more readily accessible form.

A new section called Mineral Uses replaces the former section which listed the minerals according to elements. It covers not only the ores of the minerals but also the useful non-metallic minerals. This section absorbs the material given in the second appendix (Mineral Statistics) of the preceding edition.

The material on mineral occurrence now presents not only a statement of where each mineral occurs, but how it is formed.

A Mineral Index has been added at the end of the book, listing alphabetically the 197 minerals described in the book, and 120 others as well. Besides listing the names of the minerals, it also includes in tabular form such data as chemical composition, crystal system, specific gravity, and hardness.

480 pages *Illustrated* *6 x 9* *$4.00*

JOHN WILEY & SONS, INC., 440 FOURTH AVENUE, NEW YORK

uses one of the new synthetic, rubber-like plastics known as polyvinyl alcohol. This is stretched out from three to eight times its original length, which gets its molecules all parallel with each other; then it is exposed to an iodine solution, which enables the molecules to filter the light into all-one-way (polarized) waves.

Use of polarizing sheets as headlight glare eliminators has been contemplated for a considerable time. If the headlights are screened at an angle of 45 degrees so that they will send out only polarized light waves, and if the driver uses a similar screen on his windshield, the blinding glare of oncoming headlights is eliminated. The new kind of Polaroid promises to bring headlights and eye-screens of this kind closer to realization.

The new Type H Polaroid is said to transmit a third more light than earlier types of polarizing sheets, and yet when two sheets are turned at right angles to each other practically no light at all gets through. In tests with the sheets turned completely at right angles, a hundred-watt lamp behind them became completely invisible.

Almost perfect freedom from color, together with high efficiency and polarizing power, are expected to make the new sheeting especially suitable for scientific and military optical instruments, camera filters for color photography, projection of three-dimensional pictures without color distortion, glareless illumination for stores, desks and art galleries, and for other purposes. The materials used in the wholly synthetic polarizing sheeting are coke, lime, air, water and iodine.

In another invention patented at the same time, Mr. Land offers a curtainless window which can transmit more or less light at the user's will, simply by stretching a sheet of the new synthetic sheeting between two panes of glass. The inner surfaces of the panes are coated with thin films of the polarizing substances, with axes at angles to each other. The intervening elastic sheet, with axis at a third angle, cuts off most light when it is not stretched tight. The tighter it is stretched, the more light is permitted to pass.

ITEMS

HARRY BERMAN, curator of the Harvard Mineralogical Museum, has used the cyclotron, in a new rôle, to make green diamonds. The technique is simple: put an ordinary white diamond in the cyclotron and bombard it with high-speed atomic particles for an hour and it becomes a gorgeous dark green gem. Studies show such cyclotron-treated diamonds to be virtually identical with naturally occurring green diamonds which are given their tint by long-term exposure to radioactive substances. The cyclotron bombardment, because it is considerably more intensive than that from radioactive substances, simply acts to speed up the process.

BRACKEN, a tall, tough fern that is a rank and troublesome weed in Scotland, may help to solve Britain's wartime paper shortage and thereby defray the cost of its removal. Bracken is a common and wide-spread plant in the United States, but has never entered the nuisance class in this country. In Scotland it takes possession of whole fields and pastures. Not even goats will eat it, and it seems to have no natural enemies. The only way to control it is to mow it several times a year, but this is impracticably costly unless some use can be found for it after cutting. Hence the paper-making experiments. In some parts of the Orient the young fronds are used as an asparagus-like vegetable dish. However, white men did not find it palatable when they tried it; even a 24-hour soaking in salt water before cooking failed to remove its objectionable bitterness.

SELECTED strains of inbred sweet corn from England, parents of some of the better hybrid varieties, according to Dr. W. R. Singleton, of the Connecticut Agricultural Experiment Station, will be sent to the United States. Dr. Singleton has been in correspondence with a leading English plant breeder, C. D. R. Dawson, of London, and has asked him to send small quantities of his inbred seed corn, so that the strains may be kept going until after the war. Sweet corn is a luxury crop in England, and there will be neither land nor time to spare for it this spring. Mr. Dawson has tried out American sweet corn hybrids which he has received from Dr. Singleton, and pronounces them quite good, under English conditio He has also developed a successful English-American hybrid sweet corn, of which he has sent seed to Dr. Singleton.

FISHING on the lower Tennessee Valley Authority reservoirs is similar to that found on several northern lakes, was reported by Clarence M. Tarzwell and Lawrence F. Miller, fish specialists, Tennessee Valley Authority, before the meeting of the American Society of Ichthyologists and Herpetologists. They estimated that these great artificial lakes accounted for over 1,100,000 "man days" of fishing in 1940. Careful counts were made of fishermen on the four lower reservoirs of the Tennessee Valley Authority: Guntersville, Wheeler, Wilson and Pickwick, from March to December, 1940. Such factors as day of the week, condition of weather, and fishing modes and sites were taken into account. Analysis showed that fishing was most intensive in April, May and June, after which it declined to the season's low in December. At first there was a weekly cycle, but later bad weather was the main thing that kept the fishermen at home. Most fishing went on just above and below the dams, and near centers of population; least fishing was observed in the upper reaches of the reservoirs and on the wide waters above the dams.

DIVE bombers, as well as planes flying horizontally, are taken care of with a new automatic fire control system devised by Earl W. Chafee, of the Sperry Gyroscope Company. It is designed to operate even from a moving ship, pitching and tossing in a rough sea. Details of the invention (U. S. Patent 2,235,826) include an intricate electrical and mechanical system, connected with the range finder and automatically moving the guns. When the plane is sighted the mechanism calculates its exact distance and direction. To devices previously invented which do this for a fixed position, Mr. Chafee has added a second converter. First is figured the plane's position relative to fixed axes, then these are converted, with the aid of a gyro-compass, to a position relative to the ship. Since the guns are on the ship, they are then properly aimed. Another part automatically figures out where the plane will be going, even if it starts diving, and keeps the guns aimed at the target.

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In the second revised edition, practical aspects are given particular emphasis. Two new chapters have been added—one on geology in engineering, another summarizing the subject matter of physical geology and explaining its relation to earth history.

In writing this book technical terms have been omitted wherever possible, and although brevity has been a principal consideration, many explanations have actually been amplified for greater clarity.

A special effort has been made in this revision to unify this book and the "Outlines of Historical Geology," by Schuchert and Dunbar, so as to make the two books even more adaptable for use in a unit course. The illustrations have been greatly improved by the addition of numerous new block diagrams and air views. Such up-to-date problems as those of soil conservation and flood control are considered.

Second Edition Ready June 1941

Approximately 374 pages; 247 illustrations;
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By **CHARLES SCHUCHERT,** *Professor Emeritus of Paleontology,* and **CARL O. DUNBAR,** *Professor of Paleontology and Stratigraphy. Both at Yale University.*

Constant and careful revision has made this book a well-organized, authoritative textbook for a brief course presenting a general survey of the history of the earth. In the fourth edition, each chapter presents changes designed to bring the content up to date. Principles are emphasized.

Fourth Edition Ready August 1941

Approximately 241 pages; 151 illustrations;
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N.B. For those who prefer their physical and historical geology in one volume, these two books will again be bound together under the title "Outlines of Geology." ($4.00)

JOHN WILEY & SONS, INC.
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SCIENCE NEWS

Science Service, Washington, D. C.

INFANTILE PARALYSIS

CLUES for predicting where infantile paralysis outbreaks are likely to occur in the summer are pointed out by Dr. C. C. Dauer, epidemiologist of the Health Department of the District of Columbia. Dr. Dauer suggests in a report in the current issue of Public Health Reports, issued by the U. S. Public Health Service, that the clues point to a possible outbreak of the disease in Virginia this coming summer.

The epidemics may not always come off as predicted. The clues which foretell the possibility are found in the number of infantile paralysis cases occurring in a given locality in the late fall and early winter. Dr. Dauer finds from examining epidemic records as far back as the big 1916 infantile paralysis epidemic, when 27,363 cases were reported from 27 states, that when there are a relatively large number of cases in a community at such a season, that community and surrounding area is likely to have a severe outbreak the following summer.

Although no preventive of infantile paralysis has yet been discovered, Dr. Dauer suggests that the possibility of predicting where summer epidemics may come will give investigators a chance to test any preventive measures that may be devised and to carry on valuable preliminary studies on the epidemiology and immunology of the disease. The records show, he says, that "several counties in eastern Kentucky and western West Virginia which had a high incidence in the fall of 1939 appear to have been the focus from which the infection spread to the surrounding area in the summer of 1940. Likewise, the small group of counties in Iowa which reported poliomyelitis in larger numbers than usual in the fall and winter of 1939–1940, appear to have been the center from which the epidemic in that area may have spread the following summer. Several counties in northern Wisconsin reported a number of cases late in the fall of 1939 and a considerable number in January and February of 1940. In the summer of 1940 the disease began to appear first in the area comprising these counties and in the counties of the upper peninsula of Michigan immediately after. Such occurrences as described above are not unusual since several similar instances are to be found in the past decade."

As to this coming summer, Dr. Dauer points out that: "In the state of Virginia poliomyelitis cases were reported in larger numbers than usual during the months of November and December of 1940. Most of these late cases were reported from counties in the southwestern part of the state. It will be interesting to see if this instance of occurrence of the disease in this locality in the late fall will be the forerunner of a more wide-spread outbreak in Virginia and the surrounding area in the summer of 1941."—JANE STAFFORD.

THE DIAGNOSIS OF CANCER

HOPE that a new chemical instrument, the polarograph, might be of value for the diagnosis of cancer has faded, according to a paper presented at the meeting in Cleveland of the Electrochemical Society. The report on the instrument, which gives a rapid and accurate test for tiny amounts of chemicals, was made by Drs. T. Klatt, H. P. Rusch, A. Dirksen and V. W. Meloche, of the department of medicine and the department of chemistry of the University of Wisconsin.

The instrument was invented by Professor J. Heyrovsky, of the University of Prague. It has been used in Europe for several years, but only recently has come into use in this country. Describing the instrument at the recent meeting of the American Chemical Society, Dr. Alois Langer, of the Westinghouse Research Laboratories, who had worked with Professor Heyrovsky, explained that it is capable of measuring chemicals in billionths of ounces, by recording tiny electric currents passing through the solutions being tested. With it problems can be solved in minutes that would require hours by the older methods.

The use of the polarograph is to measure small amounts of copper in a solution as other chemicals are gradually added to remove portions of the copper. Essential parts of the apparatus are a reservoir of mercury, a small storage battery and various electric meters. The mercury is fed through a tiny glass nozzle, in tiny droplets no larger than the head of a pin, into the solution being tested.

"When electric voltage from the battery is applied to the solution," said Dr. Langer, "a chemical change takes place on the surface of the mercury drop that is about to leave the nozzle. A new drop is formed every few seconds to maintain a clean surface for the chemical action. To measure the amount of copper in the solution, we set the electric voltage at the specified amount for that substance, as we would tune in a radio to a certain station. Then we read a dial which tells the amount of electric current passing through the solution, thus indicating the amount of copper it contains."

It was explained that a solution that contains many substances may be analyzed by "tuning in" the voltages which correspond with the various substances and reading the electric currents. Earlier studies had seemed to hold out the prospect that the polarograph might be valuable in cancer diagnosis. However, studies on blood sera from cancerous rats, mice and human beings gave discordant and overlapping results, leading to the conclusion that the device "can not be used as a specific test for cancer, especially in the presence of other diseases. As a test to distinguish between an advanced carcinoma and a normal the polarographic method is entirely sensitive and accurate, but as an aid to differentiate between other diseases and cancer, between early stages and normalcy, and between the malignant and the benign, and this is where the need lies, one can not help but conclude that the polarograph is quite limited."

In other fields, according to Dr. Langer, the instrument has great possibilities in simplifying the work. He suggested that after further study, it might be used to measure hormones and other body fluids and vitamins in such foods as orange juice and milk.

THE VIRUS OF INFLUENZA

THE disease-causing unit of the virus of influenza is only an eighth or perhaps a tenth the size previously believed, although that was much too small to be seen with powerful microscopes.

The diameter of each disease-causing unit of influenza virus is 10 millimicrons or less, Dr. Leslie A. Chambers and Dr. Werner Henle, of the University of Pennsylvania School of Medicine, conclude from measurements reported at the meeting in Chicago of the Federation of American Societies for Experimental Biology.

A millimicron is a millionth part of a millimeter, which in turn is only three hundredths of an inch long.

Since it was not possible to see such tiny particles, they were measured in various indirect ways by using powerful centrifuges that separate particles of known size from still smaller ones, studying the speed with which particles move through a liquid and checking the calculated measurements with the electron-microscope. Although this instrument will show particles as small as 20 millimicrons in diameter, it did not show the influenza virus particles. The eight or ten times larger particles which had been thought previously to be the individual units of the flu virus are now believed to be normal components of body cells which carry the tiny virus particles.

Not only influenza virus but a virus used to make smallpox vaccine and another virus commonly found in the brains of mice are also much smaller than previously supposed and are probably carried on the larger particles which were believed to be the virus particles themselves. This was discovered by Dr. Jaques Bourdillon, also of the University of Pennsylvania, in studies of the rate at which viruses moved through a solution. The smaller particles believed to be the real viruses move more rapidly, he found, than the larger, carrier particles.

TRAINING FOR PSYCHOLOGISTS

AN urgent appeal for intensified professional training for future psychologists able to deal with problems outside the schoolroom was presented to his colleagues by Dr. Walter S. Hunter, of Brown University, speaking on April 17 as president of the Eastern Psychological Association, which met at Brooklyn College on April 18 and 19.

Pressing social problems demand both scientific ability and general experience and wisdom, he said. "If a psychologist were given the problem of devising the best form of illumination for night driving which would at the same time favor the driver and handicap an airplane observer the solution could only come from a careful study of the application of scientific knowledge to the particular conditions specified. If, on the other hand, the task were one of raising the general level of group morale, wisdom and experience would count for as much as scientific knowledge."

With the increased demand for social service, professional training should be made more rigorous, not relaxed. Students of psychology should intensify their study of other sciences so that later they can work with physicists, chemists, or biologists on problems which involve these fields. Specialization, as in medicine and engineering, should come only after a mastery of the fundamentals of the science. Interneships for psychologists who have their doctor's degree, like those for medical doctors, should be provided. Such opportunities for supervised practice of psychology are important for those who intend to work outside of research and teaching.

Dr. Hunter pointed out that "There is a crying need for the establishment by a few of the larger universities of professional schools for psychology where men and women can be trained for non-academic work in industry, child clinics and mental hospitals." Undergraduate students in psychology at the better universities are already receiving broad scientific training. Examination of students beginning their work for advanced degrees showed that those training in psychology have a better balanced undergraduate training than either physicists or chemists. For instance they know more about biology than any other group except the biologists themselves.

ORIGIN OF "LO-HAN"

"LO-HAN," a widely used Chinese drug of hitherto mysterious origin, has finally been traced to its origin, and has proved to be a new plant species, and given a name of its own, by Dr. Walter T. Swingle, of the U. S. Department of Agriculture.

The drug, widely used in China and in Chinese communities in this country as a household remedy for colds, sore throat and minor digestive upsets, is a kind of gourd, cured by heating over a slow fire. Its pulp, intensely sweet, is used in making a kind of sweet soup, not palatable to most Occidentals. The fruits command a high price—about 20 cents apiece in Chinatown stores in this country.

An expedition sponsored by the National Geographic Society finally traced the lo-han to its lair. It is not grown by Chinese, but by a primitive people known as the Miao, in the rainy mountainous interior province of Kwangsi.

The lo-han fruits are produced by vines, of which only the ones bearing female flowers are cultivated. The Miao, primitive though they are, have learned how to hand-pollinate the female flowers with male flowers gathered wild in the woods. They sell about a thousand tons of the fruits annually to Chinese merchants, for transport to the coast cities and for shipment abroad. The flowers are described as an inch and a half or more in diameter, with yellow corollas. The fruits, when fresh, are greenish yellow or dull reddish brown, ranging from hen's-egg to goose-egg size.

The plant has been identified as a member of a large genus that ranges throughout the Old-World warm lands, known as *Momordica*. Dr. Swingle has named the new species *Momordica Grosvenori*, in honor of Dr. Gilbert Grosvenor, president of the National Geographic Society, who, he states, "for many years has encouraged liberally the geographic and botanical exploration of China." The new name and a technical description are published in the *Journal* of the Arnold Arboretum of Harvard University.

THE MEXICAN EARTHQUAKE

THE earthquake in the City of Colima, in Mexico, on April 15 was first noticed in the United States by interference with the testing of electrical apparatus by Dr. Frank Wenner and his aides, which the National Bureau of Standards was doing for the Army Signal Corps.

About 2:20, the delicately balanced mirrors on three large galvanometers began to swing abnormally, and kept it up for more than an hour. Dr. Wenner knew that a violent earthquake was going on somewhere, and judged from the behavior of his instruments that it might be in Mexico. Not until hours later did belated wire reports bring confirmation.

The earthquake may have set off the reported eruption of Colima volcano, in the opinion of Dr. Emanuel G. Zies, volcanologist of the Carnegie Institution of Washington. This volcano is the westernmost of a string of such peaks that mark a high ridge running in an approximately east-west line across Mexico, and joining the coastal range at this point. It is one of the most active mountain-forming regions according to Dr. Zies, so that stimulation of an eruption by an earthquake might well occur. Ordinarily earthquakes and volcanic eruptions have little to do with each other, despite a wide-spread impression to the contrary.

The epicenter of the earthquake was about 75 miles southeast of the City of Colima, was reported by the U. S. Coast and Geodetic Survey, after a study of data wired and radioed to Science Service by a number of observatories ranging from Ottawa to Manila. The spot of greatest disturbance was provisionally fixed as in latitude 18.5 degrees north, longitude 102.9 degrees west. This is in an isolated mountainous region in the state of Michoacan. The exact time of origin was 2:09.8 P.M., E.S.T.

Observatories reporting were those of the University of Alaska at College, Alaska; the University of Hawaii at Honolulu; Manila Observatory, Manila, P. I.; the Dominion Observatory, Ottawa; Pennsylvania State College; Georgetown University, Washington, D. C.; the Franklin Institute in Philadelphia; the University of Michigan at Ann Arbor, and the stations of the U. S. Coast and Geodetic Survey at Tucson, Ariz., and Ukiah, Calif.

"PINE OATS" FOR CATTLE

FINLAND'S forests are being called on to make good the country's present shortage in cattle feed, in the production of an emergency ration known as "pine oats." The product is claimed to be quite successful.

"Pine oats" is made by a modification of the ordinary process for producing soda paper pulp. The wood is chipped into small pieces, which are cooked in a pressure kettle with a soda solution. The cooking is kept up longer, and at higher pressure and temperature, than is the case with ordinary paper pulp. The longer it is cooked, the more digestible is the final product. After cooking, the pulp is watered down to the consistency of thin gruel, washed free of sand and twigs, and spread on screen trays to be drained of water and dried in an oven. Then it is chopped into fine bits, about the size of oat grains, and stored until needed.

Cattle fed on an experimental diet consisting exclusively of "pine oats" got along all right, but gave little milk. For regular feeding, a cow is given a daily ration of 6½ pounds of "pine oats," 6½ pounds of hay and a third of a pound of mineral salts. Current production of the new feed is 500 tons a day.

Finnish chemical engineers are also undertaking the large-scale production of sugar from wood. This sugar is not quite as sweet as beet sugar, but is said to be quite satisfactory in making preserves, jams and similar products. Two wood-sugar factories are now under construction.

ITEMS

THE American Institute of Nutrition was requested at its meeing in Chicago to plan a diet for the Belgian people consisting of inexpensive foods which could be sent to them to counteract malnutrition. That anti-rickets vitamin D, morale vitamin B_1, vitamin A and bone-building calcium were scarce in the Belgian diet even before the German invasion, was reported by Dr. Lucien Brouha, now at the Harvard University Fatigue Laboratory. The Belgian pre-war diet was also overloaded with carbohydrates, it was found in a survey made at the request of the Ministry of Public Health of Belgium in the fall of 1939 by the National Council of Nutrition, of which Dr. Brouha was a member.

A NOVEL type of steam locomotive, with two small cylinders in a V-type mounting to turn each drive wheel instead of the two single big cylinders on each side coupled to all the drive wheels with a connecting-rod, has just been granted U. S. patent 2,237,728. Thus, an engine with four drive wheels would have eight cylinders on a side, two above each wheel. In effect, each pair of wheels connected by its axle constitutes a separate, four-cylinder engine. The inventor is a German, Ulrich Barske, of Kassel-Harleshausen, who has assigned his patent rights to the firm of Henschel und Sohn, of Kassel.

INTENSIVE vitamin therapy used on patients suffering from polyneuritis caused by alcoholism does not allow the patient to leave the hospital any sooner than treatment with the routine hospital diet that contains adequate but not excessive vitamins, according to a study of eighteen years of experience by Dr. Madelaine R. Brown, of the Boston City Hospital, who reported the results to the *Journal* of the American Medical Association. Alcoholics suffering from the painful disease did not seem to be able to utilize more vitamins than are adequate in the case of a healthy person.

THE death rate from lockjaw (tetanus) was cut to half of the accepted 50 per cent. or higher mortality rate cited in medical literature in a series of a hundred cases reported in the *Journal* of the American Medical Association by the late Dr. Hyman I. Vener and Dr. Albert G. Bower, of Los Angeles. Not considering 12 patients who died within the first 24 hours of hospitalization, the net mortality rate was 19.3 per cent. Antitoxin and methenamine were used in the treatment. The reduction in mortality rate occurred wholly among men patients, the rate for women remaining approximately 50 per cent.

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SCIENCE NEWS

Science Service, Washington, D. C.

PAPERS READ BEFORE THE AMERICAN PHILOSOPHICAL SOCIETY

STRUCTURAL MODELS OF ATOMS

IN his Franklin Medal lecture on April 24, Dr. Hugh S. Taylor, David B. Jones professor of chemistry at Princeton University, described his studies with atom models 100,000,000 times natural size. He credited his student, Bernard Becker, with working out many details.

By studying the effects of various substances on beams of electrons or x-rays, it is possible to deduce the arrangements of the atoms to form their molecules. The individual atoms are so small, however, that even the new super-power electron microscope would have to be twenty times more potent to observe them individually.

Knowing the arrangement of the atoms, models may be made of special little wooden blocks. Formerly these were held together with pegs, but now they are joined with snap fasteners, like those used in clothing. These have the advantage that long chains may be subjected to various kinds of handling without falling apart.

He finds that the silk protein, fibroin, consists of long chains of links called peptides. Each consists of atoms of carbon, hydrogen, nitrogen and oxygen. The silk fibroin chain is fully stretched, but with hair and wool protein, or keratin, there are at least three forms. In one the links are folded, but when stretched, it resembles the silk.

Dr. Taylor stated that "The stretched form, or beta-keratin, is not the normal form of hair keratin. Normal or alpha-keratin must be a folded structure. It is these folds which are drawn out when the fiber is stretched and the stretched condition may be 'set' by exposure to steam heat while the tension is maintained. It is this process of 'stretching' and 'setting' which has attained the dimensions of a fine art, common to both sexes, in the 'permanent wave' and 'set' and in the 'trousers crease.' As is also well-known to both sexes, this imposed change is only temporary, the hair or wool reverting gradually to its normal folded alpha-keratin structure." He also found that muscle fiber, or myosin, has "the extension and contraction characteristic of hair fiber." The contraction and return to normal, he stated, are chemically induced.

Perhaps these studies may aid in a better understanding of cancer. Models were made of stubstances that cause cancer. It was found that there appeared to be some correlation between their power to produce the effect and the extent to which the atoms were all in one plane or not. The structure of vitamins, hormones, sulfanilamide and other new drugs is being studied. From these, perhaps, it will be possible to find out how they work in the body.

COSMIC RAYS

The cosmic rays that continually bombard the earth from outer space seem to be mostly of protons, the heavy parts of atoms, rather than electrons. New evidence in favor of this theory is contained in experiments reported by Dr. Arthur H. Compton, of the University of Chicago.

He told of various measurements made of the cosmic rays far above the surface of the earth, from airplanes and balloons. Some of these measured the number of particles that came in which were capable of penetrating thick blocks of lead. It was found that most of the particles which could get through an inch and a half of the metal were able to traverse some seven inches. Many electrons are stopped by the magnetic field of the earth. Those with enough energy to penetrate this field, and so to reach the lead blocks, should be stopped by only four inches of lead. On the other hand, the observations fit in with the idea that protons, with positive electrical charges, are the primary cosmic rays. When these strike the nuclei of atoms in the air, they produce mesotrons, which constitute an important part of the cosmic radiation observed on the earth's surface.

Dr. Compton also reported observations by V. C. Wilson, W. P. Jesse, M. Schein and E. O. Wollan, who used detector tubes carried aloft in airplanes and balloons. These showed that an inappreciable number of mesotrons are produced below 3¾ miles' altitude. At about 5 miles the production becomes strong, and increases up to at least twelve and a half miles. "At the highest altitude, where the barometer is two centimeters of mercury, the number of mesotrons is at least as great as the number of incoming cosmic ray particles as estimated by Millikan and his collaborators."

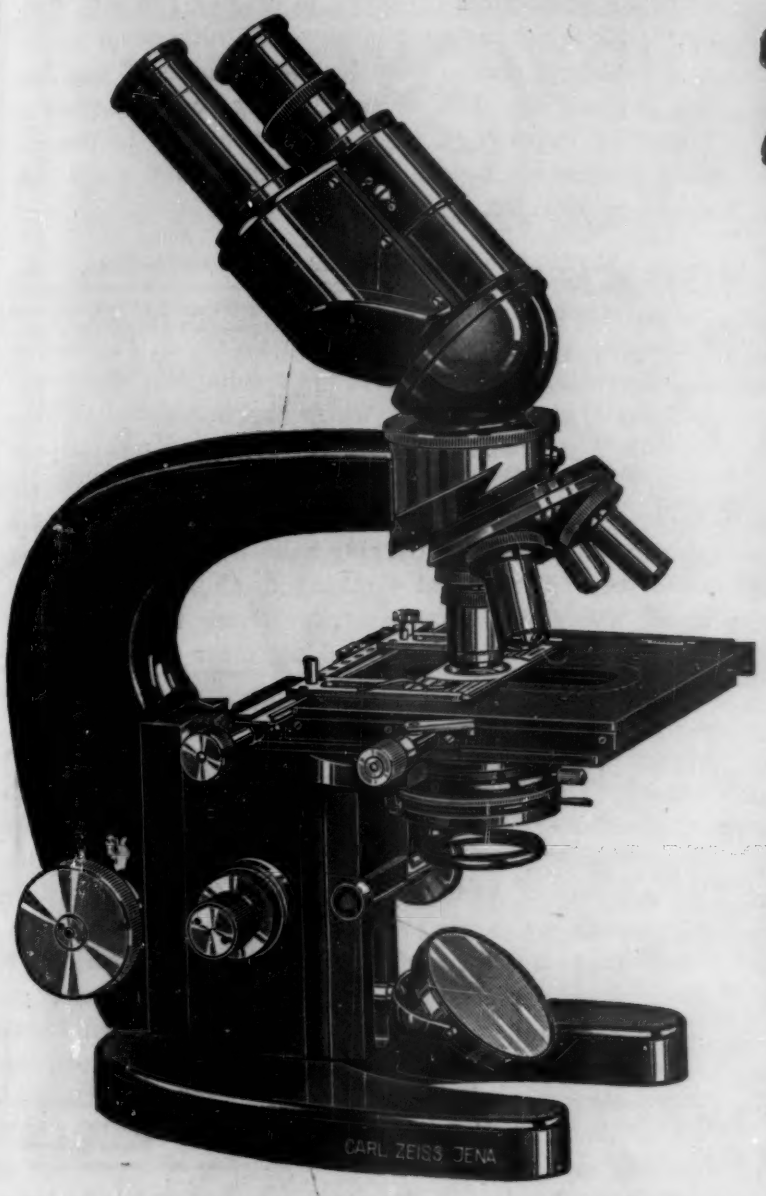
Another experiment by G. Herzog and W. Bostick made use of a cloud chamber between the poles of a powerful magnet. The chamber shows, by a fine line of water droplets, the passage of one of the various particles. With it there were found many slow mesotrons, which are exceedingly rare at ground level. The production of positive and negative pairs of slow electrons was also noticed.—JAMES STOKLEY and FRANK THONE.

THE NATURE OF INTELLIGENCE

Intelligence is only a probability that the person possessing it will act in a certain way under certain conditions. It is not an inner essence or a faculty of power that can be isolated and measured as the chemist can measure the elements. This view of mental abilities was expressed by Dr. Edward L. Thorndike, of Teachers College, Columbia University.

"Three or four hours' testing of a person with suitable intelligence tests or meters," Dr. Thorndike said, "gives a score which is highly indicative of how well he will do in school, how likely he is to escape confinement in an institution for the feeble-minded, and how well he will understand the sermons he hears, the policies for which he votes, and the like. It is usefully indicative of his fitness to make wise decisions as a parent, neighbor and citizen. Such a score obtained at age eight to eighteen is equal or superior in value to a careful physical examination at that age by an expert physician."

Psychologists would like to be able to isolate each individual mental ability, as the chemist does his elements,



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and measure all of it and nothing but it. But unfortunately for science and perhaps fortunately for man, mental abilities do not occur in pure form in any person. Each score that the psychologist can obtain from his measures is contaminated by the influence of other abilities—it is a mixture. By the mathematical procedures known as factor analysis, components or factors have been isolated that would be pure if we could get measurements of them in real people, but psychologists vary widely in their opinion of the result. "Some expect that the factors discovered will inaugurate great advances in knowledge about, and control of, human abilities. Some think that these factors are unrealizable abstractions, like an animal defined as 40 per cent. man, 30 per cent. turtle, 20 per cent. shark and 10 per cent. earthworm."

Dr. Thorndike stated that psychology will not be satisfied until it succeeds in relating mental abilities to their causes, bases, parallels or counterparts in the brain and nervous system. Not much is known along this line at present, although some former errors have been eliminated. "We now know that a brain is not much like a system of factories and storehouses interconnected by railroad tracks. It is more like a telephone and telegraph system with the added feature of more or less permanent modification by all the connections made and messages sent. It may include an elaborate system of resonators. What corresponds to an ability is more like a system of connections and modifications involving all army or navy activities than like a regiment of cell-bodies. The cell-bodies indeed may only nourish and care for the conducting parts of the neurones. What the pattern of the neurones' actions is may often be more important than which particular neurones they are."—MARJORIE VAN DE WATER.

MILITARY PSYCHOLOGY

The lead in military psychology has passed from America to the Nazis, according to Dr. Robert M. Yerkes, of Yale University.

In the World War, American psychologists pioneered by making their methods serve the Army and Navy. Dr. Yerkes is himself distinguished for the services he rendered the nation at that time, particularly in the development of the psychological testing and classification system which has been used successfully in industry ever since.

But after the war, Dr. Yerkes said, America neglected the field of psychology applied to the service of the state, while Germany took the initiative and leadership. Research and training centers were established in Germany and hundreds of men were trained for psychological service to the state.

Now the Nazis have an unparalleled organization to deal with problems of propaganda, morale, personnel and like matters of human engineering. The United States has no comparable organization, few military psychologists, and no training schools in Army or Navy to meet prospective needs.

Dr. Yerkes pointed out that psychology has other than military values for defense. "In the interest of social progress it would seem incomparably more important to improve human nature and increase the ability and usefulness of the individual, than, in accordance with our current concentration of effort, to prolong life into senility." He urged the establishment of professional schools of psychology, similar in principle to those of medicine and engineering, with courses leading to the degree of Doctor of Psychology. For those who wish to practice their profession licensing under federal and state laws should be provided.

MOTIVATION, LEARNING AND ADJUSTMENT

Dr. Edward C. Tolman, professor of psychology at the University of California, stated in the R. A. F. Penrose, Jr., Memorial Lecture that in his opinion the World War and the "ghastly picture which the international scene exhibits" are due to irrational and diseased mental processes, especially in Germany.

The recent fad of working off anger by smashing a plaster figure with a satisfying noise is an example of the same sort of irrational thinking displayed by the Germans, who feel that they can overcome the barriers to their own well-being by smashing other nations. This irrational process is known to psychologists as "displaced aggression." Because of the fact that it is irrational, such a diseased way of thinking can not readily be overcome by logical argument or education. Another such irrational and diseased mental process is termed "group identification." It is what makes the German feel that the successes of the German Army and the Nazis are actually equivalent to his own individual happiness and success. These irrational mechanisms have their start when, often in early childhood, the individual can not get things essential for his own well being. He then substitutes, illogically, the successes of his family, school, economic class, nation, or even "hemisphere," and the leaders of these groups, as though they were identical with his own success.

Germany's relatively Spartan system of childhood training, as well as the hardships suffered recently by the German people, is blamed by Dr. Tolman for the widespread development there of diseased thinking. "The only cure for Germany," he said, "would be a less rigid and Spartan system of training and a less mystical belief in German 'Blut und Boden.'"

Dr. Tolman pointed out that in Italy, due to type of family and school discipline, youthful frustrations are probably not so great as in Germany and come more from the actual poverty of the country. Their diseased "identifications" are less in Fascist Italy, and less successful, than in Nazi Germany.

In America, the essence of our democracy has been, in the past, the ever-repeated breaking down of tendencies toward such irrational identifications with the state and its rulers. Our free family life, schools and democratic political procedures have insured that the welfare of the group or its leaders should not be regarded as more important than the welfare of the individual. "But today," according to Dr. Tolman, "all is threatened. We Americans, like the denizens of the Old World, are beginning to talk primarily about group survival, group success, group enemies."

We need to ask ourselves, he said, how far this is logical and how far we, like the Germans and Italians, are indulging in irrational, diseased group identification—

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how far the depression and recession, the horrors of unemployment and all the consequent suffering and frustrations have led us into displacing our aggressions against enemies abroad rather than against true barriers at home. In any case, he said, if the thinking is irrational and diseased, it grips us and we can not give it up. If it is rational, we don't want to.

He sees only two ways out. We must work for some larger, more powerful, more international group to emerge from this war in which our children and our children's children can more safely and happily "identify." And we must see to it that the sacrifices demanded of individuals here are not so unreasonable as those demanded in Germany, remembering that only the well-being of individuals can build a good and worthy society.

"A surviving America," he said, "with the same soil erosion, pellagra, discrimination against racial minorities, and unemployment will not have been greatly worth the throwing away of our steel, our oil and our sons."—MARJORIE VAN DE WATER.

THE GROWTH OF CANCER

That cancerous tissue growing between the pupil of the eye and the curved, transparent front surface can be watched as if through a window, and studied in detail with a microscope, was reported by Professor Balduin Lucké and Dr. Hans G. Schlumberger, of the University of Pennsylvania. Their investigations have led to new knowledge of the way a cancerous growth spreads.

Professor Lucké states that "such observations have led to the conclusion that the pattern of cancerous growth is influenced decisively by surface forces. Thus, if the outgrowths from the cancer extend into the cavity of the eye where they are completely surrounded by fluid, and where in consequence interfacial forces are equalized, the resultant form is cylindrical. If, instead, the outgrowths make contact with a firm surface such as the lens, the interfacial relations become such that the edges of the growing tumor are drawn over the lens, forming a spreading membrane. If, however, the proliferating tumor pushes into the clefts of a loose tissue, such as the iris, the invading cells become arranged as spheres or cylinders, again through the operation of surface forces."

It was also possible to study cancer growth through a far wider range of temperature than is possible with higher animals, because the frog is cold-blooded. Growth was observed at temperatures ranging from only a few degrees above freezing to that of a warm summer day. Low temperatures retarded growth, high temperatures speeded it. At low temperatures the outgrowths were short, stubby, solid, whereas the more rapid growth induced by warmth produced long, branching outgrowths that tended to become bulged with fluid.—FRANK THONE.

THE CAROLINA "BAYS"

New evidence on the formation of the mysterious "bays" in the Carolina coastal plain was offered by Professor Douglas Johnson, of Columbia University. These "bays" are not arms of the ocean, but shallow elliptical or pear-shaped depressions in the sandy plain, their bottoms now filled with alluvial soil, sometimes swampy, sometimes dry. It has been suggested that they were all made by a single bombardment with fragments of an enormous meteorite that shattered as it fell, but Professor Johnson and a number of other geologists are now convinced that they originated through the action of huge natural artesian springs bringing great volumes of water to the surface from subterranean streams.

One of the arguments for meteoritic origin of the depressions is that their longer axes all trend in the same direction, as they would if they had been plowed up by a great charge of super-shrapnel. However, Professor Johnson pointed out, their axis-direction is not uniform: in parts of the country it is northwest-southeast, but elsewhere nearly straight north-south. This could be better explained by seeking the cause in the direction of water currents shifting the material loosened by the springs, sometimes in the direction of the surface slope, sometimes in the direction of the slope or pitch of subsurface rock structures. The springs themselves would tend to shift up-current, resulting in the formation of elongated craters. If the spring flow remained uniform, the elongated crater would become an ellipse; if the flow increased, the crater would enlarge as it migrated, becoming pear-shaped. Direction of flow of ground water would also deflect the upwelling water of the springs, causing migration of the craters, and hence changing their shapes.

Characteristic of the "bays" is a pile-up of sand into a low ridge at one end, usually the southern or southeastern end. Professor Johnson explained this by pointing out that the loose sand carried up into the lakes formed over the craters would respond to the effects of lake currents by piling up on the down-current side of the crater wall, whereas on the more agitated up-current side it would be carried out and spread more uniformly on the lake bottom.

OTHER PAPERS

Production of diphtheria antitoxin in crystalline form was announced before the meeting by Dr. John H. Northrop, of the Rockefeller Institute for Medical Research Laboratories at Princeton, N. J. The first step was the formation of a precipitate, by mixing diphtheria toxin with serum from a horse which had been immunized against the toxin. This precipitate is a mixture of toxin and antitoxin. The toxin was digested away with trypsin, one of the digestive enzymes, leaving the antitoxin in solution. Further treated with ammonium sulfate, the solution yielded a more highly purified, unstable, crystalline protein in the form of small plates. This protein has antitoxic properties, which remained unchanged after three recrystallizations.

Professor G. H. Parker, of Harvard University, stated that catfish have two ways of darkening their skins but only one way of turning themselves pale again. Nerve-end action, producing the compound known as acetylcholine, causes partial expansion of the melanophores (dark bodies in the skin), and a gland secretion, called intermedine, completes the darkening process. The dark bodies are caused to contract by the action of the familiar gland secretion, adrenalin, making the fish pale again. Heavy doses of acetylcholine injected into fish may cause death, but intermedine does not have injurious effects even in very large quantities.

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SCIENCE NEWS

Science Service, Washington, D. C.

"ELASTIC REBOUND" THEORY OF DEEP EARTHQUAKES

A NEW theory of earthquakes which explains why there are so few aftershocks following deep-seated tremors, in contrast to the many which follow "surface quakes," was offered before the Washington meeting of the American Geophysical Union by Dr. L. Don Leet, director of the Harvard University seismograph station.

The theory, the first that explains shocks originating miles below the earth's crust, was made from scientific records obtained in a series of New England shocks last December which Dr. Leet described as the best ever obtained near the center of an earthquake and the most complete ever obtained in New England.

The basis for the new theory was the finding, made in the Harvard Geophysics Laboratory by David T. Griggs, that rocks which flow under tremendous pressures may break, then heal, and then flow again. Previously it had been believed that in the so-called "area of flow," miles deep in the earth where confining pressures are terrific, the rock would remain in a state of flow and would not break.

Dr. Leet's explanation is that in deep quakes, such as those which shook New England in December, the flowing rock material heals quickly after a break and resumes steady flow again, thus producing only a few aftershocks. In surface earthquakes, however, like the San Francisco and Japanese tremors, the break is not healed quickly due to the lack of high pressures, and readjustments occur as hundreds of minor aftershocks. The December quakes in New England, which were centered near Lake Ossipee, N. H., were felt over an area of 350,000 square miles, and though they caused relatively negligible damage, were in the "potentially destructive" class. Even the great San Francisco quake in 1906 was felt over an area hardly greater (400,000 square miles), and he added that had the Ossipee quake been centered in an urban area the damage and casualties would have been great.

In his paper, read by the Reverend Daniel Linehan, S.J., of the Weston College seismograph station, Dr. Leet stated that the Ossipee quake was centered twenty-one miles below the surface, with the area of disturbance extending up to the granitic layer of the crust, nine miles deep. The underground area of disturbance must have had a diameter of more than twenty miles, he said.

According to the new theory, this great underground area at the center of the quake has been subjected for many years to a distorting stress of some kind, in addition to the great confining pressure. Under the distortion, the rock flows continuously until the breaking point is reached. Then the rock breaks suddenly under the strain. This may happen every century or two, and explains the first earthquake at Lake Ossipee on December 20.

The second shock, on December 24, was probably due to a gigantic underground rebound from the first quake. The records indicate that the first shock drove the top of the underground disturbance area up into the elastic granitic crust, which is nine miles deep. Four days later this crust reacted and drove back the rock mass. This is indicated by the fact that on December 20 the quake registered on the Harvard instruments as a great underground "push." The quake on December 24, on the other hand, registered as a "pull" in the opposite direction.

Dr. Leet stated that the theory of the mechanism of earthquakes at the surface, developed at the time of the San Francisco quake, does not explain the deep-seated New England earthquakes. This so-called "elastic rebound" theory explains that the granitic crust is bent, over a period of many years, until it breaks and rebounds into place, causing the earthquake.

Eight seismograph stations collaborated with Harvard in obtaining the data on the Ossipee quakes.

WHITE DWARF STARS

INSIDE the white dwarf stars, like the curious companion of Sirius, the dog star, which is so dense that a cubic inch of its material, though still gaseous, would weigh a ton, no hydrogen is present, according to Dr. R. E. Marshak, of the University of Rochester. He estimates that the temperature deep in such stars is about 10,000,000 degrees.

It is believed that these dwarf stars are made up mostly of "degenerate" gas. That is, instead of being made of atoms, they consist of swarms of single electrons, which are building blocks of atoms. A great many more electrons can be packed in a given space than atoms which are many times larger.

In the process by which the stars are normally kept fueled, nuclei of atoms hit each other and hydrogen is transmuted into helium, with carbon, then nitrogen, then carbon over again, and so on, as intermediate stages. At the high densities of the white dwarfs, if this process were operating, collisions of the nuclei would be much more frequent, and consequently these stars should give off many times as much heat as the sun, yet really their output is considerably less. Dr. Marshak, in explanation, says that there is practically no hydrogen in these stars, except, in a few cases, in an outer shell a few hundred miles thick.

Without hydrogen, he attributes the production of energy of the white dwarfs to contraction. That is, the energy released as the outer parts fall to the center is converted into heat. Proposed nearly a century ago, a similar theory was once given in explanation of stellar energy in general, but it was shown that it would not provide energy for the times over which the stars seem to have been in existence. Dr. Marshak says that it would suffice to keep the white dwarfs going for 100,000,000 years at least, and after that they will become dark objects.

Dr. H. A. Bethe, of Cornell University, whose theory of the hydrogen-helium transmutation as the source of most stellar energy is now generally accepted, also adressed the meeting. Dr. George Gamow, of George Washington Uni-

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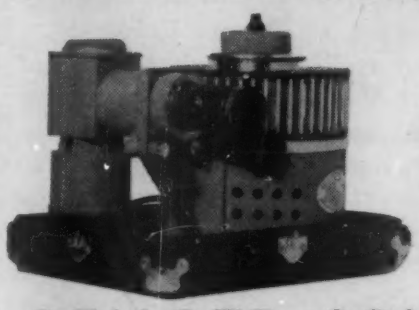

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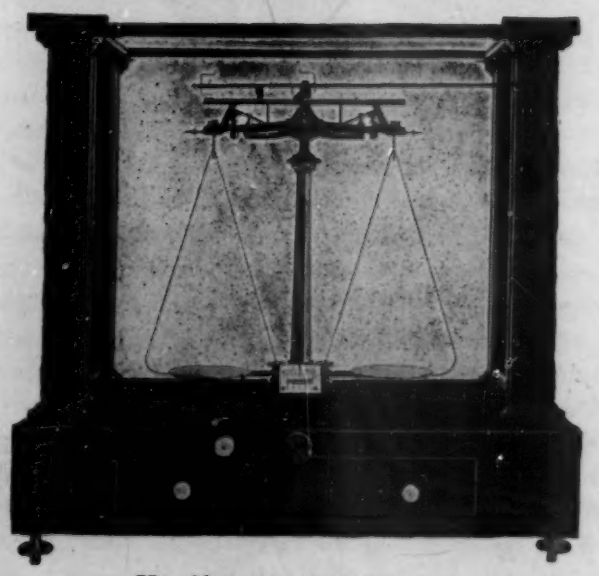

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versity, who presided, spoke on his theory that stellar explosions are due to particles called neutrinos, which have no mass.

THE TRANSMUTATION OF MERCURY

MERCURY has apparently been turned into gold by the cyclotron, or atom-smasher, at Harvard University. This experiment, which may realize the ancient dream of the alchemists, was reported at the Washington meeting of the American Physical Society by Dr. Rubby Sherr and Professor Kenneth T. Bainbridge.

However, the amount obtained was so exceedingly minute that only by an indirect method was its presence shown. Further, it is a form of gold that rapidly vanishes. It decays like radium. With one form detected, after 48 minutes, half of a given amount is gone; after another 48 minutes, half of what remains, and so on. The other forms lasted a few days.

Dr. Sherr and Professor Bainbridge shot heavy hydrogen nuclei, or deuterons, from the Harvard cyclotron, at lithium, from which high speed neutrons were obtained. These, in turn, were used to bombard mercury. A tiny amount of gold was mixed with about a pound of the bombarded mercury. The mercury, being a liquid, was boiled away in a vacuum, leaving behind the gold, which is non-volatile. A chemical process removed small amounts of platinum which were also formed by transmutation of the mercury.

Tests of the gold showed several forms which acted like radium. One was the new kind, with half decaying in 48 minutes. Also were present forms that have previously been found by other means, with half-decay periods of 65 hours and 78 hours. However, since the gold itself had not been subjected to the neutron bombardment, and had not originally shown any radioactivity, it appears that these were formed in the mercury itself. Putting more gold with it, they all joined together, and could be more easily removed. In other words, the additional gold was the bait which drew the transmuted gold atoms to it, so that they could all be pulled out together.

THE GULF OF CALIFORNIA

THE Gulf of California has been a "steady" feature of the American landscape for several million years, Dr. Harald U. Sverdrup, director of the Scripps Institution of Oceanography, stated before the annual meeting of the American Geophysical Union. Studies from the institution indicate that the Gulf "existed in essentially its present form before late Pliocene time," which puts its beginnings well before the last great Ice Age.

It is essentially a long submarine valley, broadly V-shaped in cross-section, caused by the sinking of the earth's crust below sea level. The same sag in the crust runs northwestward into California, dropping below sea level (though without flooding) in famous Death Valley. There have been some additional sinkings here and there in the gulf since it was first formed, producing deep troughs and basins in its floor. Deep terraces along the sides of the Gulf can be explained in part as remnants of the old floor, prior to the development of the inner troughs.

While survey parties afloat have been studying the gulf, Dr. George F. McEwen of the Scripps Institution staff has been carrying on a special study of the amount of water poured down the course of the Colorado, the one great river that empties into it. It is hoped that this study will eventually make possible seasonal forecasts of the amount of water that can be expected to come down the river.

The seagoing research program of the Scripps Institution has involved constant use of the laboratory yacht *E. W. Scripps* over extended periods. Ten-day cruises were made from March to June of last year, starting every 16 days. This year's program calls for a cruise to start every 24 days.—FRANK THONE.

A NEW GERM-KILLING CHEMICAL

(Copyright, 1941, by Science Service)

A CHEMICAL from the earth itself, the most powerful germ killer yet discovered, better even than the sulfa drugs themselves, has cured in a remarkably short time an array of difficult and dangerous human ills, according to reports from the Mayo Clinic and the Massachusetts Memorial Hospitals to the American Society for Clinical Investigation meeting in Atlantic City, N. J.

The new chemical is gramicidin. It is produced by bacteria that live in the soil. Its discovery was announced in 1939 by Dr. René J. Dubos, of the Rockefeller Institute for Medical Research, but the reports presented at the meeting are the first on the use of gramicidin in human patients.

Empyema from pneumonia, sinusitis, bladder infections and dangerous and hard-to-cure staphylococcus infections in wounds are the conditions that this new chemical remedy cured in remarkably short time. Infected wounds were freed of all bacteria within twenty-four hours after gramicidin treatment, following which the wounds rapidly healed, was reported by Dr. Charles H. Rammelkamp and Chester S. Keefer, of Boston. "This is a distinct advance inasmuch as former antiseptics would not rid the wound of bacteria without seriously damaging the tissues."

Sinus infections were cleared up within 48 hours, according to Dr. Wallace E. Herrell and Dr. Dorothy Heilman, of the Mayo Clinic. Severe bladder infections which the sulfa drugs do not affect were cured within one week. Gramicidin is the most highly effective agent yet discovered for stopping the growth of bacteria. Trials on twelve patients at the Mayo Clinic were reported in detail, although three more have also benefited from the new chemical.

It has one disadvantage. It breaks down red blood cells by the process called hemolysis. This toxic property of the new chemical remedy was discovered at the Mayo Clinic in experiments with the chemical on pieces of tissue growing outside the human body. A way was found to prevent this red blood cell-destroying action. It can be accomplished by heating the gramicidin. The heating, however, reduces its effect on the disease germs.

Gramicidin, therefore, can not be used, unless heat-treated, where it will come in contact with the blood. This means it is not suitable for injection into the veins. It can, however, be safely injected into such cavities as

the sinuses, the bladder, and infected but not bleeding wounds and any local infections such as ulcers. White blood cells, which are part of the body's defense against disease germs, are not harmed by gramicidin.

The potency of gramicidin is shown by the fact that one gamma, or one thousandth of a milligram, of the substance will stop the growth of virulent streptococcus and pneumonia germs in tissues. One milligram is the equivalent of slightly more than one hundredth of a grain. The strongest concentration of the material used in treating patients at the Mayo Clinic was 400 gamma per cubic centimeter.

HEPARIN

ONE of the greatest unsolved problems facing surgeons in their life-saving operations, the formation of peritoneal adhesions after operations inside the abdomen, may soon be conquered. Promising results in prevention of adhesions by heparin, the anti-blood clotting substance obtained from cows' lungs, were reported by Dr. Floyd Boys, assistant professor of surgery at the University of Virginia Medical School, at the meeting at Richmond of the Virginia Academy of Science.

Peritoneal adhesions, Dr. Boys pointed out, are one of the chief causes of the dangerous condition, intestinal obstruction. They result from the organization of an inflammatory exudate or juice lying between opposed injured surfaces of the peritoneum, which is the membrane lining the inside of the abdominal walls.

"At first the exudate is unclotted," Dr. Boys explained, "but it soon becomes coagulated and an adhesion composed of fibrin is formed. If, and when, the opposing peritoneal layers covering the organs in this zone are destroyed by inflammation, the exposed sub-peritoneal connective tissue and blood vessel elements are stimulated to proliferate (grow) over the fibrin which acts as a scaffolding. By this process, termed organization, the fibrinous adhesion is replaced by scar tissue and a permanent adhesion remains." Between one and two of every one hundred major abdominal operations, it is estimated, are performed for relief of intestinal obstruction due to such adhesions.

Many methods have been tried to prevent these adhesions during the one hundred and fifty years since the condition has been known. None, however, has proved satisfactory. When purified heparin was developed for prevention of dangerous clots within blood vessels, Dr. Boys and Dr. Edwin P. Lehman, professor of surgery at the University of Virginia, believed it might prevent adhesions also by preventing the coagulation of the inflammatory peritoneal exudate which is the starting point of adhesion formation.

Studies on rabbits and dogs were so promising that the heparin treatment for prevention of adhesions was used in a "few cases of intestinal obstruction" in humans "without any untoward effects." The chief danger in the use of heparin lies in the possibility of hemorrhage within the abdomen, but care during the operation to prevent bleeding from the small veins and arteries should eliminate this danger.

Dr. Boys pointed out that "an enormous number of cases must be treated with heparin before a sufficient number of cases will come to re-operation or post-mortem to offer a basis for judging the efficiency of the method employed. It would seem necessary, therefore, that primary acceptance of such a method must rest upon laboratory and animal assay evidence. If the experimental value of heparin in preventing peritoneal adhesions is confirmed by other investigators, its use should offer considerable promise for this heretofore essentially unsolved surgical problem."—JANE STAFFORD.

ITEMS

Special centers known as carotid bodies, that normally control the reactions of the blood vessels, have much to do with the violent convulsions that are typical symptoms of cyanide poisoning, according to a report presented at the recent meeting of the American Philosophical Society by Professor Carl F. Schmidt, of the University of Pennsylvania. In the carotid bodies, fine blood vessels are brought into intimate contact with groups of nerves. It has long been held that the chemical state of the blood produced effects on these nerves, and through the brain and other parts of the central nervous system these effects were reflected in all parts of the body. Thus, through strong poisons the carotid bodies can throw the whole body into convulsions. Professor Schmidt made a test of this by severing the nerve supply to these bodies in properly anesthetized laboratory animals. When sodium cyanide was injected into their veins, no convulsions occurred, despite the fact that the doses were rather large, though short of lethal size.

A link between patterns of mental behavior and the laws of other sciences were demonstrated at the meeting of the American Philosophical Society by Dr. Karl S. Lashley, of Harvard University. Thinking, perceiving and other mental activities, Dr. Lashley indicated, are associated with activities of the nervous elements in the brain's cortex which have many of the same characteristics of pattern or organization. Psychological study of how you perceive objects or happenings through signals from the eyes, ears or other sense organs reveals laws or organization identical with physical laws of force-fields. Electric potentials in the sensory areas of the brain point to complex interplay of interference patterns or of field forces. "Thus neurology and psychology are approaching a common formulation of the laws of organization of their materials. In studies of motivation and of the variables contributing to intellectual activity there is a similar confluence of the two disciplines toward a common statement of principles of organization."

ELEVEN lively, wriggling infants have been born to a female ball python at the Hershey Estates Zoological Garden at Hershey, Pa. This is a complete upset of a long-held zoological doctrine, still printed in all the books, that all pythons are egg-laying snakes, according to Ward Walker, director. Plenty of snakes bear their young alive, including such common species as water-snakes and garter-snakes, but until now the Old-World pythons had not been known to be anything but egg-layers. The ball python gets its name from its habit of rolling up into a compact ball when disturbed or frightened. It can then be rolled about rather roughly, but refuses to uncoil. Its native home is West Africa.

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A considerable amount of new material has been included in the treatment of the topics mentioned above, and many new illustrations have been added.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE CORONIUM

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ASTRONOMERS are excited by news from Sweden that one of their colleagues, Dr. Bengt Edlen, has found a satisfactory solution for the problem of "coronium"—which they once thought was an unknown element causing a strange green line in the spectrum of the sun's outer shell, its corona.

Dr. Edlen ascribes this and other mysterious lines to broken atoms, with many more electrons removed from their shells than had been supposed. His researches indicate that there is some yet unidentified but powerful excitation from the sun that breaks these atoms. They also indicate that the sun is sending to the earth very short ultra-violet rays, which possibly play a part in producing the ionized layers of our atmosphere and make long distance radio possible.

Dr. Polydore Swings, Belgian astronomer now on the staff of the Yerkes Observatory, in describing the research, states that it is "most certainly the most brilliant attack ever made upon the problem of the line spectrum of the solar corona." Dr. Swings was associated with Dr. Edlen in previous researches and spent some time discussing this with him in the summer of 1939.

The line spectrum of the corona has been observed for about seventy years at the times of total solar eclipses, and, in recent years, with an instrument called the coronagraph. This spectrum, produced by passing the coronal light through a prism, or reflecting it from a grating ruled with thousands of lines to the inch, shows more than twenty lines, some quite conspicuous. Most prominent is a green line. There are also two red ones, two in the infra-red and one in the ultra-violet. The last three are not visible, but can be photographed. Many previous suggestions have been made to explain them, but these have been unsuccessful.

Dr. Edlen proposes that they are so-called "forbidden" lines, that is, lines due to atomic changes which can not take place under ordinary circumstances. However, such changes do occur in the great gaseous nebulae in the sky. As a result of laboratory tests, he concludes that the atoms in the corona are much more highly ionized than has previously been considered. That is, more of the electrons which revolve around in them, like the planets in the solar system, have been removed. The green line, he suggests, is caused by iron atoms thirteen times ionized. By some as yet unexplained excitation, thirteen of the electrons are removed from the iron atom. The next three strongest lines, the two in the infra-red and the one in the ultra-violet, he ascribes to iron atoms from which twelve electrons have been removed. Weaker lines are caused by nine and ten times ionized iron, while eleven and twelve times ionized calcium and eleven, twelve, fourteen and fifteen times ionized nickel accounts for others.

"The general result," said Dr. Swings, "points to a maximum abundance for ions with ionization energy of about 400 volts and the source of such a tremendous excitation is very puzzling. Edlen concludes that 97 per cent. of the coronal line emission is now explained and that the coronal matter has a chemical composition similar to the average composition of the meteorites; this suggests a possible origin for the coronal matter."

A NEW ELECTRICAL MUSICAL INSTRUMENT

USING vacuum tubes and electrical circuits like those of television transmitters, a newly patented musical device will play tones of any instrument desired. Invented by Ralph W. Bumstead, Westfield, N. J., the patent, 2,241,027, has been assigned to the Radio Corporation of America.

Even though two different instruments, a piano and violin, for example, may play the same note, they sound different because of the harmonics. From a tuning fork a pure A, for instance, may be obtained. But when this note comes from any of the instruments generally used, there is not only the fundamental A, consisting of vibrations at the rate of 440 per second. Mixed with it are vibrations of multiples of this figure, the harmonics. The first, 880 per second, is an octave higher than the fundamental, and so on.

One common type of electric organ uses a series of wheels, with scalloped edges, which rotate in a magnetic field, and set up fundamental tones. There is a wheel for each note. By combining them in different ways, the combination is produced, which has the effect of some other instrument. But this is limited, because, as Mr. Bumstead points out, the tones of an organ pipe or a single instrument may include as many as thirty harmonics, and cumbersome apparatus would be needed to provide each one of these.

In his invention, only one element is used, to give the fundamental, and this smooth wave has impressed upon it irregularities corresponding to the final result that it would have if all the harmonics had been added. This is done by means of an iconoscope tube, the "film" of the television camera, on which the picture is formed.

The scalloped wheel, or a tuning fork, makes the fundamental, and controls the beam of electrons which sweeps across the iconoscope's sensitive screen. On this is projected, from a miniature magic lantern, the silhouette of a mask cut to correspond with the desired sound wave. Since the response of the screen is different in the light and dark portions, the electrical current that comes out is amplified, and passes to the loud speaker where it is converted into sound, has the wave form of that from the instrument for which the mask was made. One form of the invention illustrated in the patent, shows a series of masks on a film, which may be rolled into place. Thus, by changing the mask, the pressure of the key may be made to give a note of organ, oboe, clarinet, violin, flute or perhaps some combination which might not correspond to any existing instrument, yet be of exquisite beauty.—JAMES STOKLEY.

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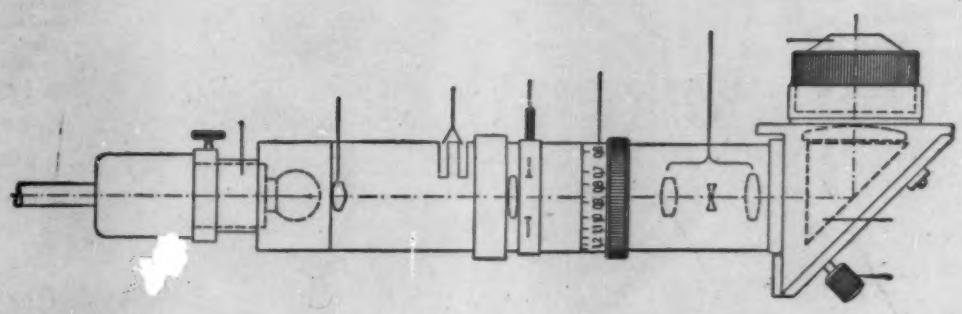

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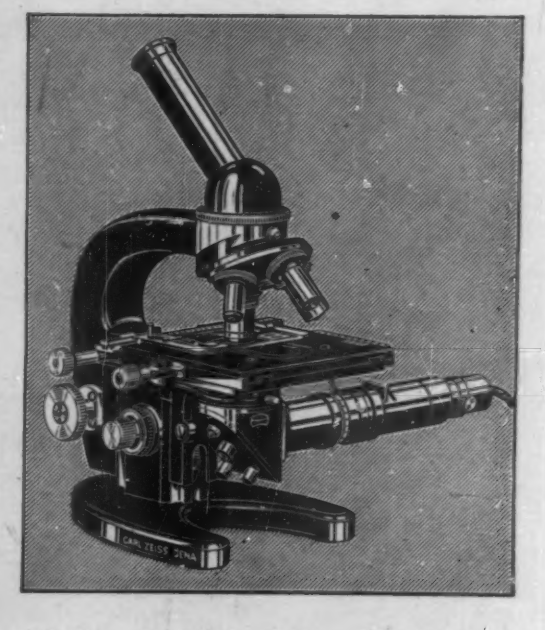

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RADIO WAVES

PROFESSOR BOBERT C. COLWELL, H. Atwood, Jr., J. E. Bailey and C. O. Marsh, of West Virginia University, have found that radio waves have "practically the velocity of light," in experiments which were reported to the recent meeting in Washington of the American Physical Society. The speed of light is about 186,000 miles per second.

They set up a transmitter on the campus at Morgantown, which broadcast ten pulses a second, each lasting for a hundred thousandth of a second. This was received by a portable unit which automatically sent a return pulse, in its turn received at the first transmitter. There, both the original and the return signal were shown by a luminous line on a tube like that used in television receivers. This indicated the total time taken for the round trip. Part of it was due to actual transmission between the stations, the rest was the delay in operation of the parts of the radio equipment.

First, readings were taken with the portable station near the fixed one. Then it was moved farther away and more measurements made. Since the instrumental delay was the same in both sets, the difference between the measurements "is the time taken for the radio pulse to travel twice the distance between the two positions of the portable station."

The measured velocity in the line of sight, they stated, came out practically the same as that of light.

MACHINE PARTS MADE FROM POWDERED METAL MASSES UNDER PRESSURE

ALTHOUGH science has not yet found out exactly what happens in the process, the making of metal parts for machinery used in defense and other industries from powdered metal under heat and pressure promises a new industrial revolution. The Axis powers have already made wide use of these methods to speed their production, but they are now coming into extensive use in this country, according to Dr. Harvey N. Davis, President of Stevens Institute of Technology, which is inaugurating a special laboratory for powder metallurgy.

As an example, Dr. Davis cited the oil pump gear of a 1940 automobile. "Previous to the production of this gear from powders it was customary to produce it from a cast iron gear blank by generating the teeth in a highly specialized gear shaper. It was startling to find that a gear possessing comparable physical properties could be accurately produced in large quantities by simply filling a mold with an iron or mild steel powder which would pass through a one hundred mesh screen, subjecting the powder to a moderately high pressure of approximately 15 tons per square inch and applying a consolidating and welding heat treatment to the pressed powder compacts. The molded gear proved in service to be lighter, more nearly noiseless, and in every way more satisfactory than the machined cast iron product, and it was produced at a fraction of the cost of its predecessor. Many other articles have been similarly produced from ferrous and non-ferrous powders and it is becoming generally accepted that in a great many applications, the molding of metal powders will eventually replace other production methods."

Development of these methods may lead to amazing results, according to Dr. Davis, who continued: "Imagine, for example, an exhaust valve for an airplane engine, fashioned and completely finished to exact size in one operation, the rim of which is composed of a special alloy peculiarly well fitted to hold an accurate seating surface, while the cap merges over into another alloy specially fitted to resist high temperatures, and the stem is made of still a third alloy specially fitted to withstand wear as it moves back and forth through its guides. Of course, many new problems, such as differential thermal expansion, to say nothing of the as yet unsolved problems of the diffusion alloying of the steels themselves, would have to be worked out, before such a valve could be made. But here, as everywhere in the field of powder metallurgy, the slogan of its devotees is never 'impossible' but always merely 'not yet.'"

Cutting tools used in lathes, millers and similar machines used for making other machines, are made in this way, for instance, the cemented carbides "which have proved to hold such an important position in our present defense program as superlatively high-speed cutting and metal working materials." The Axis powers, he said, are believed to have gained much of their large-scale production by the use of similar cemented carbide cutting tools applied to ordnance and munitions.

No one yet knows exactly how minute particles of metal are made to adhere so tightly on one another at temperatures far below their melting points. Another mystery is why some mixtures shrink considerably, while others, almost the same, shrink hardly at all. To understand more fully the finer points of these phenomena and to apply them intelligently in industry, it was decided to establish the powder metallurgy laboratory at Stevens Institute. Here technical personnel will be trained, researches will be made with the cooperation of several large manufacturing corporations which have established fellowships, and the unknown fundamentals will be investigated.

EARWORMS AND SWEET CORN

IF you want to keep earworms out of the patch of sweet-corn that you have just now hopefully planted, carry on chemical warfare against them with mineral oil, is advice given by the U. S. Department of Agriculture. The time for attack is when the ears are shaping up and the silk, having performed its function in pollination, is beginning to wilt.

Plain mineral oil squirted into the silk at the ear-tip will get rid of earworms if they are still very small. If they have had time to get their growth started, the oil should be fortified with dichloroethyl ether, a chemical readily obtainable on the open market. A quarter of a teaspoonful to an ear is sufficient. It can be applied with an ordinary oilcan, for small gardens; force appliers with larger reservoirs are available for commercial growers. Since earworms travel quite readily every ear in the planting should be protected. This can be done easily in

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EARLY MAN IN AMERICA

ROUGH stone knives and other tools used in the beach life of early Canadians, apparently more than 10,000 years old, have come to light near Lake Huron in the region of Manitoulin Island, Ontario.

Excavation of a workshop where ancient people turned out quartzite knives as big as daggers, some of them ten inches long, and rough cleavers up to seven inches long, was reported by Dr. Emerson F. Greenman, of the University of Michigan, to the Society for American Archeology, which met in Minneapolis in conjunction with the central states branch of the American Anthropological Association.

Dr. Greenman reported that the beach is estimated to be 10,000 to 15,000 years old. The site is now four miles from the shore and 297 feet above the present level of Lake Huron.

Some of the knives and a graving tool used by the ancient Canadians are similar to the equipment used by the famous Folsom Men of ancient America, whose big-game hunting life some 10,000 to 20,000 years ago is becoming known through discoveries in various parts of the United States. Similar knives, described as semi-lunar in shape, large and coarsely flaked in technique, have been found in at least three other places in Canada —in northern Labrador, in Quebec province and Alberta. All these sites were near the water, and all, according to Dr. Greenman, were found "under conditions suggesting a high antiquity."

Discovery of mastodon bones in the kitchen refuse pits of a large prehistoric house near the Mississippi River south of St. Louis was reported by Robert McCormick Adams, of the Academy of Science of St. Louis.

It is not clear from the discovery, Mr. Adams pointed out, whether man and mastodon were contemporaries in the St. Louis region, and whether man hunted and possibly cooked and ate mastodon meat there, or whether American natives who lived long after ancient elephants vanished from America found mastodon bones as curios.

Excavations for an office building in Boston in 1939 brought to light remains of a fishweir, which has since attracted fourteen investigators to the scene to study Boston's prehistoric fishing conditions. Reporting that the weir is probably 5,000 years old, and upsets scientific views on antiquity of prehistoric man in the area, Frederick Johnson, of Phillips Academy, Andover, said that the weir was used over a long period of time and repaired frequently. A joint volume will be issued on what has been learned from this buried scene about the oyster bed, the molluscs, the barnacles, pollen that shows what the plant life was like, the geologic conditions, and the description of the weir which called for driving 65,000 stakes and forcing layers of brush between them to form a barricade.

ITEMS

FIGURES compiled by the National Wildlife Federation indicate that forest fires during the month of April swept over more than 1,300,000 acres of timber land, principally in the South and East. Translated into terms of lumber, the destruction comes close to 300 million board feet, or enough to build barracks for nearly 200,000 soldiers.

THE weather map of the United States is turned topsy-turvy, as spring advances with drought in the East and too much rain where black storms once roared out of the Dust Bowl in the Southwest. Recent showers have not materially relieved the situation in the East, although winter wheat and other crops already growing are not yet in danger. Farmers in the upper Ohio Valley have hesitated to plant corn in the dust, while in the Southwest they could not plant it in the mud. Corn and cotton already germinated in Texas, the U. S. Weather Bureau reports, are pindling and anemic-looking because of too much cloudy, wet, cool weather.

Two elements made by the cyclotron to give off rays like radium have for the first time been obtained in pure form, according to J. D. Kurbatov, M. L. Pool and H. W. Law, of the Ohio State University, who made a report to the American Physical Society. These are radioactive strontium and barium. While the former was secured by bombarding strontium oxide with deuterons, or nuclei of heavy hydrogen atoms, obtained from the cyclotron, the barium was made by transmutation from another element, lanthanum.

THE mineral molybdenite, made of molybdenum and sulfur, is a good lubricant, M. E. Bell and J. H. Findlay, of the Westinghouse Electric and Manufacturing Company, reported to the American Physical Society. They used it in x-ray tubes in which the anode is spun in order to expose different areas to the exciting rays and so avoid overheating. Oils and greases could not be employed because they evaporate and ruin the vacuum. However, the crystal structure of molybdenite was found to be suitable. It consists of laminations of sulfur atoms and molybdenum atoms, which slide over each other. Its use, they declared, "is not necessarily limited to a vacuum."

WITH a "test-tube" sixty feet high, atoms of oxygen gas of different weights have been sorted out, was reported by Dr. S. B. Welles, of Yale University, to the American Physical Society at its meeting on May 1. Ordinary oxygen in the air is made up to the extent of 99.76 per cent. of atoms of weight 16, 0.2 per cent. of weight 18 and 0.04 per cent. of weight 17. As enriched in the sixty-foot tube by Dr. Welles, the proportions of the two rare forms were increased to 14 per cent. for oxygen 18, and nearly 1 per cent. for the 17 variety. The method used was that of thermal diffusion. Down the center of the tube is a hot wire, and when oxygen is admitted, the heavier atoms go to the bottom and the lighter ones to the top.

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SCIENCE NEWS

Science Service, Washington, D. C.

CEPHEID VARIABLE STARS

CEPHEID variable stars, which change periodically in light in a characteristic manner, getting bright rapidly and dimming more gradually, may represent a stage in the evolution of another kind of star, called the "red giants," and the Cepheids may themselves turn into a star of an ordinary kind.

This theory was suggested by Dr. Edward Teller, of George Washington University, at the recent meeting in Washington of the American Physical Society devoted to sources of stellar energy. Cepheid stars are important to astronomers as measuring rods of the universe. The brighter they become, the more slowly they change. Thus, when the period of variation of one is found, the astronomer can judge its candlepower. Seeing how bright it looks, he can tell how far away it is.

The red giants are typified by Antares, in the summer constellation of the Scorpion, and Betelgeuse, which shines in the winter sky in the figure of Orion. They are many millions of miles in diameter, ten to a hundred times as big as the blue stars. The red giants are really very diffuse. If we had a piece of one on earth, we should call it a pretty good vacuum.

Though the reactions in the nuclei of atoms which yield the stellar energy are on an entirely different scale from ordinary chemical reactions, Dr. Teller said that they have the common characteristic that both are speeded with high density and temperature. Thus, more easily reacting nuclei must be present in the red giants, since these stars, in spite of their lower densities and their presumably lower internal temperatures, produce as much energy as ordinary stars.

In ordinary stars the atoms responsible for energy production are mainly those of carbon and nitrogen. However, the responsible atoms in the red giants probably are lighter ones like those of beryllium, lithium, boron and deuterium (or heavy hydrogen). Moses Greenfield, in a paper to be published shortly, discusses the consequences of these reactions in greater detail. Dr. Teller's studies indicate that the main production of energy from these atoms would sometimes not be at the center of such a star, but in a shell a little way out from the center. If this shell gets sufficiently far away from the center, the star would probably not be stable, but it would start oscillating, as astronomers believe the Cepheids to be doing. So, he concludes, the red giants may become Cepheids in one stage of stellar evolution. However, after some millions of years, the supply of the light elements would become exhausted and then the Cepheid might become an ordinary, non-variable star.

FLUORESCENT LIGHT

FLUORESCENT light, made by certain substances when invisible ultra-violet rays fall upon them, lasts for 1/1470th of a second after the exciting rays are turned off, Dr. R. D. Rawcliffe, of the University of Illinois, reported at the meeting of the American Physical Society, at the National Bureau of Standards.

This kind of light is becoming widely used in modern illuminating fixtures in which a long tube shines with a brilliant white or sometimes bluish glow. Inside the tube is a mercury arc. Though this gives little visible light, it is rich in ultra-violet rays. Lining the tube is a layer of fluorescent material, which takes the invisible rays, turns them into visible light, and sends them out into the room. Such lamps are many times more efficient than old style incandescent lamps.

Dr. Rawcliffe's work represents the most accurate measurement thus far of the time the fluorescent light lasts. He measured it by having sharply interrupted flashes, from a mercury arc, fall on a fluorescent screen. The light from the screen fell on a form of electric eye, or photoelectric cell, which has a built-in amplifier. It is called an electron multiplier tube.

It was in turn connected to a tube similar to that used for receiving television pictures, in which a beam of electrons shines on a screen, and becomes visible. It was so connected that the beam was held to the side of the tube while the mercury light was shining, but as soon as it went off momentarily, the beam started across the screen. Thus, it traces a curved line showing the way the fluorescent light decays.

His results show a decay in 1/1470th of a second, with a probable error of 3 per cent. He pointed out that this was in good agreement with an earlier measurement, using another method, which had an error perhaps of 10 per cent.

RESEARCH IN AGRICULTURAL SCIENCE

IN presenting the medal of the American Institute of Chemists to Dr. Henry G. Knight, chief of the Bureau of Agricultural Chemistry and Engineering, on May 17, Vice-president Wallace expressed the opinion that research in agricultural science will be a powerful aid in bringing about Hemisphere unity.

Vice-president Wallace, who, as Secretary of Agriculture, was Dr. Knight's chief, said that he has especially high hopes for the four great regional laboratories for research on industrial uses for farm products, and that he expects these to become Meccas for scientific men from all over the world. He pointed to the passing leadership in chemistry from Nazi-dominated Germany to the United States as striking evidence that science can thrive only in an atmosphere of freedom.

Dr. Knight, in accepting the medal, called attention to some of the outstanding contributions made by research chemists in his bureau to better living in America, and promised even greater things in the future, especially when the regional research laboratories shall have had time to get their programs into full swing. Of particular value, he pointed out, will be the pilot-plant setups in these laboratories, for in them can be wrought the transitions from test-tube scale experiments to mass production on factory basis.

As a single, dramatic example of the returns obtainable on small outlay in research, Dr. Knight cited the case

of the ethylene gas treatment of oranges, to bring a bright color to the skins of some types of fruit that persist in staying green after the oranges themselves are ripe. "The treatment bleaches out the predominant green color and leaves the orange a beautiful natural yellow. The chemical investigations leading to the development of this treatment which is now in rather general use cost the taxpayers of the country about $4,000 and is estimated to be worth about $4,000,000 a year to the producers of citrus fruits in Florida alone and about the same amount to producers in California. And yet some people say that research doesn't pay. I know it does. I think the criticism that sometimes comes to research comes mainly because the scientists are forced to try the results of laboratory investigations on a commercial scale before they have had time to pick out all the "operating bugs." That happened in the case of the sweet potato starch plant, and it's likely to happen to any undertaking that is pushed too fast. Developments and discoveries and inventions take painstaking time for checking and rechecking, and they shouldn't be pushed too rapidly."

The speaker also related the history of phenothiazine as an example of the unforeseen beneficial ramifications that often spring from research started with a definitely limited objective. Phenothiazine, a sulfur-containing organic compound, was tried out as an insecticide, in the hope that it might replace arsenical sprays in the protection of orchards and garden crops. It proved quite successful for this purpose. Then it was also found that phenothiazine could be used in medicine for the treatment of kidney and bladder infections, and in veterinary medicine to rid animals of parasitic worms.

VIRUSES

ELEVEN different kinds of viruses are now known to attack the human nervous system and to produce as many distinct maladies, according to a report by Dr. Albert B. Sabin, associate professor of pediatrics at the University of Cincinnati, who spoke at the Chicago meeting of the American Academy of Pediatrics. Viruses are disease germs so small that they can not be seen under even high-powered microscopes. Influenza, measles and yellow fever are caused by viruses, but these are not the nerve-attacking type described by Dr. Sabin.

The eleven viruses that attack the human nervous system are: infantile paralysis; St. Louis encephalitis (encephalitis is popularly termed "sleeping sickness"); Japanese encephalitis; Eastern equine encephalomyelitis (so-called horse sleeping sickness); Western equine encephalomyelitis; rabies; louping ill; lymphocytic choreomeningitis; pseudo lymphocytic choreomeningitis; "B" virus, and herpes simplex, or fever blisters.

Besides these eleven known viruses and the maladies they cause, there are at least two other diseases of the human nervous system which are probably caused by viruses although the infectious agents have not been isolated. These are the epidemic encephalitis or "sleeping sickness" which was so prevalent during and immediately after the last war and herpes zoster or shingles.

The first four viruses that attack the nervous system have caused epidemics of diseases, affecting thousands of people at a time, while the others occur only sporadically. Most of them can produce unrecognized or very mild infections without any signs of involvement of the nervous system. The virus of fever blisters is an example. It not only can invade the central nervous system of animals and produce fatal disease in them, but there is suggestive evidence that even in human beings it may wander beyond the skin and mucous membranes.

Lymphocytic choreomeningitis appears to affect mice and dogs under natural conditions but is transmitted to human beings. Pseudo choreomeningitis is a new virus recently identified in England. "B" virus occurs in monkeys under natural conditions and has been known to cause disease in at least two laboratory workers who were bitten by monkeys and presumably also in a former king of Greece.

The eleven known viruses that attack the nervous system are as different and distinct from each other as are the germs of tuberculosis, typhoid fever and pneumonia, and the viruses, even though they can not be seen under the microscope, can be identified with as much certainty as the tubercle bacillus. The identification is made by determining whether or not the unknown virus can produce disease in monkeys, mice, guinea pigs and rabbits and by estimating its approximate size from its capacity to pass certain filters and by the changes it produces in infected cells.

All these viruses except those of infantile paralysis, rabies and herpes have been isolated, recognized and identified within the past five to ten years.—JANE STAFFORD.

TRANSPLANTED EYES IN SALAMANDERS

EYES of various kinds of animals have been successfully transplanted, with return of vision, in experiments reported in a lecture in New York City by Professor L. S. Stone, of the School of Medicine of Yale University. Most of the work has been with salamanders, long-bodied relatives of frogs and toads. The transplants were made at all ages, from embryo to adult.

While the transplanted eyeballs grew into place successfully, the regaining of vision was a somewhat roundabout process. The severed ends of the optic nerve did not unite. Instead, there was a new growth of both nerve and retina, and vision was restored when this process was completed, after about two months. The same eye, Professor Stone stated, has been repeatedly grafted, with return of vision each time. He has even exchanged eyes between salamanders of different species.

Thus far, experiments with mammalian eye transplants have not been successful. When rats' eyes were transplanted, they degenerated and were resorbed into the animals' bodies, the process taking about four months. Resorption also occurred in fish with transplanted eyes.

"At the present time the opossum is being studied as the most promising mammal for eye transplantation. At birth the young are embryonic. The eye is so primitive at this time that it is in the same stage of development as a five-weeks-old human embryo. This condition

lends itself to an experimental analysis in a way that is not possible in any other mammal.''

In operations on the eyes of embryo salamanders, Professor Stone learned some new facts about the factors influencing normal eye development. The experiments showed that the formation of the lens was dependent on the action of the optic centers growing from the primitive nervous system, and that the lens could be primarily governed by an early interference with the factors underlying the primitive nervous system. ''So far as we know,'' he said, ''all vertebrate eyes, with the exception of a small group of salamanders, have no power of restoring a lost lens. . . . The common vermillion-spotted newt is an example of the rare group which has the ability to replace the completely excised lens by a growth of cells from the pupillary margin of the dorsal rim of the iris.''

HUNGER SIGNS IN CROPS

A NEW book, ''Hunger Signs in Crops,'' written by a committee of fourteen specialists and edited by Gove Hambidge, has been published by Judd and Detweiler. It describes and depicts in color some of the principal types of malnutrition in plants and tells what can be done about them.

Different plants naturally show different symptoms for the lack of any given mineral element, but there may be at least some general resemblances. Thus nitrogen starvation manifests itself as a yellowing of the leaves in several different species; most prominently along the midrib, in corn; entire lower leaves on the stalk, in tobacco; a dirty yellowish-green tinge, in cotton leaves. Other deficiencies also manifest themselves in this similarity-with-differences pattern.

Of particular importance is research on the effects of a shortage in the so-called trace elements—mineral nutrients needed only in exceedingly minute amounts, but indispensable in those amounts. Until a few years ago, it was thought that plants needed only seven mineral elements: nitrogen, potassium, phosphorus, sulfur, magnesium, calcium and iron. Needs for the first six of these are measurable in scores or hundreds of pounds per acre of crop.

But to the seven elements of classic plant physiology there have now been added another six: manganese, boron, chlorine, iodine, zinc and copper. The need for these, per acre of crop, is measurable in ounces: the equivalent of a quarter of a pound of borax, enough iodine crystals to make up one ounce of tincture, and so on. Discovery of the necessity of these trace elements has been so recent, and research results are still coming in so fast, that all statements about them must still be regarded as provisional. This new book, however, does bring together all pertinent present information on the subject.

ITEMS

SAMPLES of what the interiors of the hottest stars may be like are produced in the laboratories of the National Bureau of Standards, was reported by Dr. F. L. Mohler, to a meeting of the Society of the Sigma Xi in Washington on May 15. By suddenly discharging 40,000 kilowatts of electrical energy through a quartz tube with a one tenth inch bore, a spark was obtained lasting only five millionths of a second, but nearly 50 times as bright as the sun while it lasted, and having a temperature of 45,000 degrees Fahrenheit. New understanding of the properties of matter at extreme temperatures is expected to result from these studies.

THE capacity of the Goodrich synthetic rubber factory at Akron is being increased from 6 to 18 tons per day, was announced by John L. Collyer, president of the B. F. Goodrich Company, on May 15, while speaking as a guest on Science Service's Adventures in Science radio program over the Columbia Broadcasting System. This kind of synthetic rubber, called Ameripol, is made from petroleum, soap, natural gas and air. About a year ago the first synthetic passenger car tires made of this substance were offered to the public. American motorists have purchased at premium prices several thousand tires and several hundred leading corporations are equipping light trucks and company cars with such tires in order to get first-hand experience for use in the eventuality that natural rubber is cut off by the war. Synthetic rubber is also being used in de-icers for airplane wings and in gasoline tanks that seal themselves after being punctured by bullets.

STARLINGS, long a pest in the East, have apparently become firmly established in the Rocky Mountain region. S. W. Gadd, ornithologist of Colorado Springs, states that Colorado was entirely free of them until the winter of 1938–39. Then a group of about 75 was discovered on the South Platte watershed north of Denver. Now they are spreading into the city in large numbers. ''Recently I found a flock of starlings at the Johnson reservoir, just south of Colorado Springs,'' says Mr. Gadd. ''It is safe to predict that starlings will soon become a major worry in the Pike's Peak region and the eastern Rockies generally.''

A TINY baby is governed by the natural laws of physics and chemistry just as is a molecule or a crystal. Showing a motion picture film entitled ''Infant Eyes and Hands,'' and starring diminutive actors and actresses younger than is the normal baby at birth, Dr. Arnold Gesell, of the Clinic of Child Development of Yale University, described how the complicated patterns of human behavior are produced by the same factors and forces that are being investigated in the biochemical laboratory. ''Behavior has shape in the same sense that limb-bud and finger prints have shape.'' And shape, he said, has the same origin for patterns of mental behavior as for bodily behavior. Long before the baby comes into the world, he begins to show human behavior. More than seven months earlier than normal birth, its behavior begins to assume characteristic forms and patterns. His development follows an orderly sequence which is not disturbed by premature birth. What the baby who is prematurely born can do is approximately the same as the behavior of an unborn baby of the same age; it is not like the behavior of a full-term baby born at the same time.

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By C. C CLARK and R. H. HALL, New York University. 519 pages, 6 x 9. $3.25

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SCIENCE NEWS

(Science Service, Washington, D. C.)

THE STRUCTURE OF MATTER IN THE SOLID STATE

CHANGE in color, or wavelength, of light when, for example, it falls on a diamond, and is scattered by it, is proving "a gateway to fundamental knowledge of the highest value," regarding the structure of matter in the solid state. So stated Sir Chandrasekhara Venkata Raman, leading Indian physicist, director of the Indian Institute of Science at Bangalore, Mysore, who was awarded the Franklin Medal of the Franklin Institute of Philadelphia on May 21.

Since he was unable because of war conditions to come from India, the medal was received on his behalf by Sir Gerald Campbell, British minister to the United States. In a paper sent by Sir Chandrasekhara, which was read at the meeting, a summary was given of some of his important researches.

"A transparent crystal traversed by a beam of light exhibits an opalescence due to diffusion of the light by the ultimate structure of the solid. The phenomenon is strikingly evident when a beam of sunlight traverses a block of transparent ice. It is often possible to find extensive portions in a clear block of ice which are quite free from inclusions, and the track of the sunbeam through such regions appears of a sky-blue color, the intensity of the opalescence being about thirty times greater than the intensity of a similar track in dust-free air, but only a fraction of its intensity in dust-free water. The finest specimens of transparent quartz exhibit a similar effect, the opalescence, however, being less intense than in ice."

Early in 1928, Sir Chandrasekhara continued, he found that when a crystal or a liquid or solid was illuminated by light of but a single wavelength, as from a mercury lamp, the light which was scattered included other wavelengths. These were revealed by the spectroscope. The difference in wavelength, or color, was found to be characteristic of the substance studied. This, of course, is quite different from the colors which one sees in a crystal such as a diamond, when white light shines on it. In that case, all the colors visible are contained in the original illumination.

"On the principles of the wave-theory of light," he stated, "an ideal homogeneous crystal can not scatter light." However, he proposed that a pulsation of the network of atoms which make up a crystal might cause such scattering if it took place in a certain relation to the light falling on it.

The wavelength shift in a diamond was studied as its temperature was raised. There was a change in amount of the shift, because the diamond expanded, and the light had a greater thickness to penetrate. However, there was no increase in the brightness of the altered color, as there would had it been due primarily to the effect of heat. Consequently, Sir Chandrasekhara concludes that the pulsations in the crystal which cause the scattering of light are caused by the light itself. From these researches, he stated, it is possible to obtain important information about the way matter is put together in the solid form.

AUTOMOBILES AND STATIC ELECTRICITY

PROFESSOR ROBIN BEACH, electrical engineer of the Polytechnic Institute of Brooklyn, has found by actual measurements in his own car, equipped as a traveling laboratory, that charges of static electricity amounting to 12,000 volts or more are formed on automobiles driving along a dry road.

Possible danger from this source, in starting a fire of gasoline vapor if a spark is discharged, is indicated by his finding that, even with a stop of twenty minutes, there was sometimes no apparent decrease, indicating that many hours might be required before the charge was completely dissipated. He also found that a "drag" chain, like that which dangles from the rear of a gasoline truck and supposedly prevents a dangerous charge from accumulating, had no noticeable effect. In a report to *Electrical Engineering* he states that "since the pavement was not grounded but rather comprised a most excellent insulator, the drag chains, obviously, could not be expected to discharge the car."

The charge comes, apparently, from the transfer of electrons in two materials that are in "contact," but really separated by a hundred millionth of an inch or less. This occurs between the tires and the road surface, as well as between one's shoes and a heavy carpet, when one's body can accumulate a charge sufficient to make a sizable spark when a finger is brought near a grounded metal object. In the latter instance, he says, a charge of as much as 10,000 volts may be accumulated. Voltages up to 75,000 have been recorded, he says, in the case of gasoline and other liquids passing through pipelines, making a potential source of great danger.

The friction of rubbing does not produce the charge, Professor Beach states, but merely establishes more extensive contact between the two materials.—JAMES STOKLEY.

CORROSION

How electric currents can counteract the process by which submerged pipes act as parts of an electric battery and are corroded was described by N. A. Miller, of Universal Oil Products, Inc., at the recent meeting at Tulsa, Okla., of the American Petroleum Institute.

Mr. Miller declared that all corrosion of metals in contact with water or moist earth takes place by just one means, that of electrolytic action. In this process, the metal pipe or other structure forms one pole of a battery. The other pole may be formed by another metal, or spots of impurity or mill scale on the first. Current flows from the anode to the cathode, and the former is gradually consumed.

To counteract this process, the current must be made to flow the other way. Sometimes pieces of other metal are

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placed near by, which will become anodes more easily than the metal to be protected. Then, the latter becomes the cathode, and is not corroded. But still better is the application of a direct electric current to flow in the proper direction.

Mr. Miller described installations of such a system by oil refineries, especially in pipes of open tank condensers. Though the operating records are meager, he stated, "what information we do have indicates positive beneficial results." He urged further investigation of the subject, and pointed out that records available concern locations where corrosion was initially very bad. "Additional data are necessary to establish the economics involved in the border-line cases," he concluded.

Bacteria and other living organisms are responsible for some kinds of corrosion, which may affect non-metallic as well as metallic objects, according to W. J. O'Connell, Jr., of the technical division of Wallace and Tiernan Products, Inc. One kind, for example, affects concrete. The bacteria produce hydrogen sulfide gas, which reacts to produce sulfurous or sulfuric acid, either of which will attack the concrete. He pointed out that methods for controlling these organisms are well known, but that attention must be paid to physical, chemical, electrochemical, biochemical and biophysical aspects of the problem in applying them.

HEALTH OF LOW-INCOME FARM FAMILIES

ONLY five out of a thousand heads of low-income farm families are really in good health—free from physical defects, was pointed out at a meeting of the Population Association of America, at Princeton, N. J., in a report from Dr. R. C. Williams, chief medical officer of the Farm Security Administration.

The accumulation of defects and disabilities affecting these people, termed by Dr. Williams "reservoirs of America's defensive forces" because they contribute so much to the numbers of America's young manhood, was brought to light by a health survey conducted last year by the administration.

"So far," Dr. Williams said, "we have found no dramatic results which would show any great number of them dragging along with one foot in the grave. "But what we are finding is that they have an accumulation of defects and chronic conditions which are not serious enough to keep them from carrying on with their activities, but which cause progressive debilitation and, in some cases, partial or total disability." Of 1,005 heads of white families and their wives, only five were free from defects. Of 111 colored husbands and wives, not a single one was in perfect health. The average person is handicapped by between three and four physical defects, and even children have two or three apiece. Vitamin deficiencies are extremely prevalent.

In Maine, the eye specialist on the survey staff examined about 350 persons with slit lamp microscopy for evidence of past or present riboflavin (one of the B vitamins) deficiency. Every individual examined showed evidence of an old, existing, or healing deficiency. Over 80 per cent. showed both old and existing or new signs of deficiency. Blood plasma studies of 276 individuals, also in Maine, showed plasma ascorbic acid values below 0.4 milligrams per cent. in 38 per cent. of those examined. Such low values are usually found with vitamin C undernutrition which, when fully developed, is scurvy. Decayed teeth were found in 65 per cent. of white persons and 73 per cent. of colored. It is defective teeth that accounts for the largest percentage of draft rejections this year. These poor farm people never seem to have teeth filled. Their teeth get holes in them, remain untreated, and finally are pulled out.

Of 16,000 cases of serious illnesses among the families surveyed, more than half had received no medical care whatever. One out of three births had not been attended by a physician. Yet the total amount of unpaid doctors' bills was close to half a million dollars.

Among the white wives under 45 years old, 41 per cent. had been lacerated in childbirth; the figure was 66 per cent. for those over 45. Incidence of syphilis among the white people surveyed was low, only 0.6 per cent. It was ten times as high among the colored families. Hookworm is a serious problem, but varies in prevalence in different localities from 15 per cent. to 38 per cent. Among 4,333 white persons of all ages in eight states, 48 per cent. had defective tonsils.

Families are large among these farm people. More than 43 per cent. of the mothers studied had had five or more children and one wife out of every ten had given birth to ten or more children. One mother had nineteen children.—MARJORIE VAN DE WATER.

ITEMS

CHROMITE, source of chromium needed in high-grade steels and for plating metals, may be mined on the Kenai peninsula in Alaska, to replace imports from Turkey if the latter are cut off by Nazi conquest. Presence of the chromite deposits in the northern territory has been known for thirty years, and one of the ore bodies was worked in a small way during the first World War, but it was not until the summer of 1940 that a systematic survey of all deposits in sight was made by the U. S. Geological Survey. A preliminary report on the Kenai chromite bodies has been made by the Department of the Interior. Estimates of the quantities in sight total 150,000 tons. Of this about 70,000 tons is of shipping grade. Last year's chromite requirements in this country were 660,000 tons, of which less than one per cent. was produced within the continental United States. Turkey's share of our imports was 70,000 tons.

QUININE, like rubber, is coming back home to the Western Hemisphere. Paul C. Standley, herbarium curator at the Field Museum of Natural History in Chicago, recently returned from an expedition to Guatemala, reports that large plantations of cinchona trees, source of quinine, have been set out, financed by American capital. They will be able to produce a large supply of the best grade of quinine. Tea, native to the Orient, has become a naturalized Central American citizen. The only commercial tea plantations in the New World are in Guatemala, and they are capable of great expansion if need arises.

A New Mosby Book

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By C. E. TURNER, Professor of Biology and Public Health, Massachusetts Institute of Technology; and ELIZABETH McHOSE, Director of Physical Education for Girls and Chairman of Health Council, Senior High School, Reading, Pa. 425 pages, 164 illustrations. Price, $1.90

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SCIENCE NEWS

Science Service, Washington, D. C.

ADDRESS OF THE PRESIDENT OF THE AMERICAN MEDICAL ASSOCIATION

A THREE-POINT program to insure enough doctors for the nation's military and civilian needs and to avoid any bottleneck in the production of doctors and a stern warning to nurses that they are losing their place in the community was presented by Dr. Frank H. Lahey, of Boston, president of the American Medical Association, at the opening general meeting at Cleveland.

Point 1 in his program: Medical students and interns should not only not be drafted for army service but, as in England now, should not even be permitted to volunteer.

Point 2: Those definitely committed to the study of medicine and already in the premedical preparation period should not be drafted but permitted to continue through the medical course.

Point 3: Development of a quota system for selection of doctors for military medical service, such as has already been worked out in England.

"There has already been a greater number of volunteers from the South than from the North," Dr. Lahey pointed out in connection with this idea, "and there will probably be areas where, as a result of greater volunteering, the number of doctors available for the community will be too limited. Should the present situation become even more urgent than it is, it is conceivable that many hardships may be worked in communities."

The warning to nurses: Nurses may "educate and legislate themselves out of the important place they have held in medicine and in the community" if the present trend away from service to the patients and toward higher and higher standards of requirements for entrance and graduation in nursing is not checked.

"It is really no exaggeration," Dr. Lahey declared, "to say that, with many of the personal attentions to patients delegated to ward maids, the real art of nursing can be lost to the nursing profession."

The shortage of trained, registered nurses, increased by military demands, and the relatively high cost of nursing for patients suggests that practical nurses will have to be used to break the impending bottleneck.—JANE STAFFORD.

THE VIRUS OF INFANTILE PARALYSIS

THE virus of infantile paralysis enters the body through the mouth, not through the nose as has long been believed, Dr. Albert Sabin, of the University of Cincinnati, stated at the meeting of the American Medical Association.

If this "working hypothesis," as Dr. Sabin cautiously terms it until further studies prove or disprove it, is correct, conquest of this dreaded malady may be greatly speeded. While Dr. Sabin said nothing about practical results of his findings, any one who knows the history of disease-fighting knows that far greater strides have been made in conquering disease such as typhoid fever, whose germs enter the body through the mouth, than diseases such as the common cold, which enter through the nose. Infantile paralysis fighters, unfortunately, have seen so many promises of early conquest of the disease, such as the nasal spray blockade and vaccinations, fail, that they are naturally hesitant about expecting too much now.

Dr. Sabin's picture of what happens in infantile paralysis is, briefly, as follows: The virus enters the body by way of the mouth and establishes itself in the alimentary tract, where it multiplies, probably in the walls of the small intestine and the pharynx. It invades the nervous system by two pathways, one leading to the brain by way of the cranial nerves which supply the upper part of the tract or by way of the parasympathetic nerves from the lower alimentary tract, and the other pathway leading into the spinal cord by way of nerve fibers from the intestines. If the greater attack is along the first pathway, the illness will be of the serious bulbar type which affects the breathing muscles. If the attack is along the second pathway, the primary paralysis would be in the extremities.

In the non-paralytic and sometimes unsuspected cases, the virus is either limited in some way to the alimentary tract or an equilibrium is reached between the body and the virus before enough nerve cells have been destroyed to interfere with function and cause paralysis.—JANE STAFFORD.

SULFAGUANIDINE

SULFAGUANIDINE, the new sulfa drug that is proving a potent and swift remedy for bacillary dysentery and a life-saving aid in operations on the lower alimentary tract, now will be available to physicians generally.

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Infections with other germs in this part of the body are a great and heretofore unavoidable hazard in operations for the removal of cancer or correction of other serious disorders of the lower alimentary canal. Shortly after the discovery of the action of sulfaguanidine, therefore, Dr. Warfield M. Firor, acting chief surgeon of the Johns Hopkins Hospital and acting professor of surgery at the Johns Hopkins Medical School, tried it as a weapon against infection in such operations. Remarkable success with the use of the drug before and after such operations has now been reported.

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MALNUTRITION

WAR is declared against malnutrition among the less well-off portion of the American population low-income families as well as those on relief in recommendations that have come from the National Nutrition Conference for Defense.

No reduction in relief allowances under the emergency conditions is an important point. It is argued that a scarcity of consumer goods that threatens to drive down the real income through price advances warrants putting unemployed to work to make more consumer goods.

Employment of Negroes and other minority groups, no taxes on incomes insufficient to provide an adequate family diet, coverage of domestic and agricultural workers under social security are among the other recommendations.

Soybean, peanut and milk products that are low in cost and nutritious would be encouraged. Milk would be made cheaper and no skim milk would be wasted. Taxes that discriminate against margarine are protested.

Technically trained producers and students would be given selective service deferment in accordance with another recommendation.

Better feeding of defense workers is another recommendation, since added meals during the work period have been found to increase efficiency, reduce accidents and decrease absences.

Need for the training of cooks and other members of food staffs in restaurants, institutions, etc., was stressed.

There will be state, county, city and local nutrition conferences and committees if several recommendations are carried out.

The suggestions and reports of the nine sections of the conference that will go to President Roosevelt as the results of the three-day conference cover more than 12,000 words.—WATSON DAVIS.

THE WHEAT CROP

MOUNTAINS of wheat, bushels in absolutely astronomic number, are heaped up in America's grain elevators and storage bins, as another huge new harvest awaits the reapers, with heads already well filled at the southwestern end of the Wheat Belt. This unprecedented accumulation of basic foodstuff is one of the country's severest economic problems, and in any but an abnormal time would be an unmitigated headache.

As it is, however, there are some redeeming features about this glut of grain, so huge that all the mouths in the country could not eat it up in less than three years, even if not another bushel were added. At least, that is how Vice-president Wallace, who as Secretary of Agriculture struggled for eight years with the problem, feels about it. When I saw him briefly, a day or two ago, he had this to say:

"In times like these, it gives us a comfortable feeling to know that the new wheat crop, plus the carry-over, will provide us with the largest supplies in history. While we also have a very large carry-over of corn, there is always a possibility that unusually dry weather in July and August may damage the growing crop, and in case of need surplus wheat can be substituted for corn in the animal diet. The proteins of the two grains supplement each other."

The potential economic headache in the wheat surplus lies in the fact that without Government support this enormous mass of grain would force prices down to levels ruinous to farmers. The new bill just enacted by the Congress and signed by the President, which supports the price by loans on wheat produced under AAA contract terms to the extent of 85 per cent. of "parity," is intended to keep the farmer's purchasing power abreast of the city man's.

Criticism has been leveled at this advance in the Government loan rate on wheat, and even some of the staunchest supporters of the AAA system have had twinges of doubt as to whether the increase should have been as great. Advocates of the new act, however, state that the expected rise, from about $1 to about $1.14 a bushel, can legitimately be held responsible for a cost increase of less than a quarter of a cent per pound loaf of bread. If the price of bread goes up more than that, they claim, the rest of the boost must be looked for elsewhere—in the pay envelopes of labor, or in the profits of the processor, or in that vague category styled "general overhead."

However, regardless of controversy over the price of wheat, the quantities of wheat now in sight are simply overwhelming. The carry-over, as of July 1 of this year, is estimated at 400 million bushels—more than twice what it was three years ago. To this will be added the crop now nodding toward harvest, which is expected to roll up to as much as 850 million bushels. Thus, on July 1 there will be in this country about one and a quarter billion bushels of wheat.

Nor is that all. Canada has a much larger carry-over than we have; it amounts to 565 million bushels. Argentina has a 160 million bushel carry-over, and Australia 73 million bushels. Add in the American carry-over and you have a total of nearly one and one fifth billion bushels of wheat now on hand in these four major exporting countries alone.

The current crop now growing in Canada, and next season's crop being seeded in Southern Hemisphere wheatfields, are not included. Omitted also are the Old World wheat harvests, which because of war conditions are both unknown and uncertain quantities.

The very climate itself has conspired to increase the golden flood pouring through the grain chutes. Fall-sown wheat came through the winter in good shape, and despite drought in the East this spring has matured a good crop. All up and down the Plains region, where a few years ago drought and dust storms blasted the crop, there have been heavy snows followed by abundant rains, so that spring wheat in the Northwest and fall wheat in the Southwest are in championship condition.

Where to put it all is one of the things that is giving gray hairs to farmers, wheat buyers, millers and Government officials. If all storage space still unused is filled up, and grain is stored in bags in old warehouses hastily made weather-tight, and wheat poured into bins vacated by some of the corn now being rapidly turned into pork and milk and eggs for our own defense workers and for

shipment to Britain, it may turn the trick. But it isn't certain yet that Western farmers will not have to do what Canadian wheat growers did last year—just pile it up in enormous hills out of doors, for sheer lack of enclosed storage space. Canada, by the way, is drastically reducing wheat acreage this year by one fourth, despite the war. Times have certainly changed since 1917!

This enormous reserve of unused wheat, which will keep in good condition for several years if properly sheltered, will stand America and the world in good stead if the war should end in a general collapse of Nazi-dominated Europe, crumbling into starvation-scourged anarchy. Then wheat-crammed ships can rush to the unblockaded ports, bringing to the peoples of the Old World the one best medicine for the malady called despair. Food was sloganed to win the last war. This time, food can win the peace.—FRANK THONE.

THE FOOD SURPLUS

(*Copyright, 1941, by Science Service*)

FOOD may be the weapon used by defense officials to build up the quantity as well as the quality of the defenders of democracy.

Without some prompt action, America must face the foe of slow national suicide through dropping birth rates. But the mountains of wheat, floods of milk, and carloads of golden fruit, now a food surplus, may provide rescue from this mass self-destruction.

Several plans have been proposed for using food to increase the size of families on the theory that parents sure of food for them will have more children. The American Youth Commission suggests extending the food stamp plan so that food surpluses could be distributed to families with three or more children and with incomes below $1,500 a year. Another plan, considered by the recent National Nutrition Conference, would give the food to all families making only $1,000 a year or less, whether they have children or not. This proposal would extend the food stamp plan, now available only to families on relief, to others on a similar income level who are self-supporting. This plan, not directly aimed at increasing the birth rate, might nevertheless have such an effect by aiding low-income families to feed their children properly.

Still another plan might be adopted—one which was tried successfully in Sweden before the war. This would give the food to families with children regardless of their income. Advocates of this food-for-children plan base their proposal on the view that children are an asset to the nation. As such, they must be fed. Parents of large families should not be required to submit to investigation and prove that their incomes are inadequate and that they are "worthy," or otherwise be pauperized or humiliated. The food stamps thus become an honor to parents bringing up future citizens. They are not the badge of charity or relief.

Impetus for pushing consideration of these plans for using America's food surpluses to build up population comes in recently announced statistics of our population. If present trends continue, America faces a drop in population. Our population growth has declined from an average of about 1,700,000 a year during the 1920's to less than 900,000 a year during the 1930's, it is pointed out by Dr. O. E. Baker, U. S. Department of Agriculture population analyst. Since about 1932, we have not had enough births to maintain permanently the number of people we now have. The population will probably reach its crest in about twenty years. And that is just the time that elapsed between the first World War and the present time.—MARJORIE VAN DE WATER.

SUN SPOTS AND MAGNETIC DISTURBANCES

LIGHT beams take only eight minutes to reach us from the sun, and high speed atomic bullets cross the 92,900,000 miles intervening in a matter of hours. In addition, there may also be some strange kind of corpuscles shot out from solar disturbances which crawl along at the snail-like pace (astronomically speaking) of as little as 15 miles a second, and take weeks or months to make the trip.

This theory is proposed by Dr. Clifford N. Anderson, of the Bell Telephone Laboratories, in a report to the Institute of Radio Engineers. It would explain the difficulties often encountered in trying to connect aurorae and magnetic disturbances on the earth with sun-spots. There seems little doubt that they are closely related, yet quite often there are spots, and no terrestrial effects. Or else a magnetic storm may occur, and no spot be apparent.

Studying records back to 1921, Dr. Anderson finds a number of cases where large spots were followed at periods ranging up to 90 days by marked disturbances, without any other particular solar activity that might have been responsible in the interval. From this he suggests that the solar particles responsible for the earthly effects do not travel at constant speed, as has been supposed, but may have velocities ranging from 12 to 1,200 miles per second.

"This indicates," he states, "the difficulty of trying to forecast occurrences of individual terrestrial disturbances."—JAMES STOKLEY.

ITEMS

DROUGHT in the East and Southeast is becoming an increasingly serious problem, as late spring merges into early summer and temperatures, until now abnormally low, tend toward higher levels. Reports collected by the U. S. Weather Bureau indicate that grain crops in the Middle Atlantic States are heading up on short straw, with prospects of reduced yields. Fortunately, however, the principal wheat areas from the upper Ohio Valley westward have had at least the necessary minimum rainfall to make a good crop, and west of the Mississippi the moisture condition is better than it has been for years. In the Corn Belt, planting is going ahead rapidly, with most of the seeding already done and the crop sprouting well. Iowa reports corn planting to be eight days ahead of average. Progress of the cotton crop is reported as uneven, with rain badly needed in the eastern half of the Gulf States, and nights a bit too cool for good growth. Conditions are much better in the Texas-Oklahoma cotton region.

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SCIENCE NEWS

Science Service, Washington, D. C.

TEMPERATURES NEAR THE SURFACE OF THE SUN

TEMPERATURES of millions of degrees prevail just above the surface of the sun, instead of the 10,000 degrees that astronomers have previously measured, if the theory proposed by Dr. Donald H. Menzel, of the Harvard College Observatory, is correct.

Speaking before a conference on the sun and solar-terrestrial relationships, he said that his ideas follow from a recent discovery made by Dr. Bengt Edlen, of the University of Upsala in Sweden. This explained the origin of the previously mysterious lines in the spectrum of the sun's corona, its outermost envelope.

They are actually caused, he has found, by elements such as iron, calcium and nickel, from the atoms of which a great many outermost electrons have been torn off. Of the 26 outer electrons in the iron atom, as many as 13 are removed, Dr. Edlen found. He was able to imitate the effects in the laboratory by battering atoms with powerful electric sparks.

Measurements of the surface temperature of the sun, based on the light of the ordinary colors that comes to us, have given a value of about 10,000 degrees Fahrenheit. But, Dr. Menzel said, such an extremely low value would not fit in with the new theory, conditions of excitation must be far greater than this—around several millions of degrees—in the innermost parts of the corona. In spectrum photographs which he made at recent eclipses the outer part of the corona shows lines, but that of the part nearest the sun's surface is a continuous band of color. This indicates that atoms in this region are broken up on account of the high temperatures, and do not show usual lines.

"Perhaps the sun has sprung a leak," he said, "and these hot gases stream out from the sun's interior through holes and pores."

It might seem, Dr. Menzel suggested, that these gases, encountering lower pressures as they emerged, would expand, and the expansion would produce a great cooling. But, he speculated, it might be that great whirlpools inside the sun expand the gases before they are ejected. In that case they would still be as hot as the interior even after they were outside. This theory, he said, is preferable to others which might be offered in explanation.

Apparently the inner corona is the birthplace of the prominences, great flame-like clouds of gas which can be seen and photographed with proper instruments. Dr. Menzel announced that his associate, Walter Roberts, who is in charge of the special Harvard Observatory at Climax, Colo., for studying the sun's corona from an altitude of 11,500 feet, actually saw this happen. A flare in the corona, in which he detected the characteristic green spectrum line, condensed into a prominence, and extended down to the solar surface.

Similar formation of prominences above the sun's surface, apparently out of nothing, have been filmed in astronomical motion pictures taken at the McMath-Hulbert Observatory of the University of Michigan.

Dr. Robert R. McMath, director of the observatory, showed some of these to the meeting. According to Dr. Menzel, this may be due to the atoms recombining. Torn apart, they do not give ordinary light, and are not detected, but as they cool and their parts come together again, they give the familiar spectrum and are then visible.—JAMES STOKLEY.

THE POSSIBLE PREVENTION OF DIABETES

A REQUEST to American physicians to carry on war-interrupted efforts of Canadian scientists to test a promising method of diabetes prevention was made by Dr. C. H. Best, of Toronto, co-discoverer of insulin, and his associate, Dr. H. E. Haist, at the first meeting held in Cleveland of the newly organized American Diabetes Association.

By giving insulin, a diet high in fat content, and also by fasting, the Canadian scientists have succeeded in preventing diabetes in dogs. By any of these procedures the amount of insulin in the dog's pancreas is reduced, indicating that the insulin-producing cells of the pancreas are being given a chance to rest. Overwork of these cells with consequent breakdown of insulin-producing ability results in diabetes.

The hereditary tendency to diabetes has been so well established that Dr. Best and his associate believe the measures which prevented diabetes in dogs should be tried, under carefully controlled conditions, to protect children of diabetic ancestry from developing the disease. They have not been able to make such a trial, Dr. Best explained, because war has called to England for military service the member of the University of Toronto medical faculty who would be able to make arrangements for the trial. Dr. Best's own activities are limited to laboratory research.

A means of diagnosing diabetes in its early stages is badly needed, according to Dr. Best, pointing out that at present doctors do not see diabetic patients until most of the insulin-producing cells in the patient's pancreas are destroyed.

The death rate from diabetes is rising "at an alarming rate" and so is the number of cases, in spite of efforts being made to fight this disease, Dr. Cecil Striker, of Cincinnati, president of the new association, declared in outlining methods by which the association hopes to aid the three quarters of a million diabetics in the nation.—JANE STAFFORD.

NEW METHODS OF DRYING BLOOD PLASMA

Two new methods of drying the hundred million quarts of blood plasma for treating shock, said to be vitally needed for national defense, were announced at the opening sessions of the American Medical Association meeting in Cleveland.

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blood plasma drying method of Dr. Frank Hartman, of the Henry Ford Hospital, Detroit. The blood is collected directly into these casings, which have previously been steam sterilized. After the red blood cells have settled to the bottom, this part of the casing is tied off.

The rest, containing the plasma, is attached to the spokes of two wheels and revolved in an air-conditioned cabinet. The water from the plasma seeps through the cellophane casing and evaporates, leaving the light brown, flaky dried plasma, which can be redissolved in five minutes when the doctor is ready to give it to a patient in shock.

This method is said to be only about half as expensive as other methods of collecting and drying blood plasma. Between 45 and 50 liters (48 to 52 quarts) can be dried in 24 hours in any large hospital. For mass production, this amount could be greatly increased by using an air-conditioned room instead of the small cabinets.

With this method, the red blood cells can be saved and used, as the British are now doing, to prepare anemic patients for operation. This, Dr. Hartman estimates, gives double usefulness to every pint of blood collected and cuts the price of the dried plasma in half.

Even simpler and less expensive, and well adapted to small hospitals, is the plasma drying method developed by Dr. Samuel B. Harper and A. E. Osterberg, of the Mayo Clinic. With $20 worth of ordinary laboratory equipment and the part-time services of a technician, their method can be used to produce instantly soluble dried blood plasma. This method consists simply of distilling the plasma in vacuum at a temperature slightly above normal body temperature.

For large-scale production of dried blood plasma, Dr. Harper investigated the process used commercially by manufacturers of dried milk. He found that this method of spraying large quantities of milk into a big room to dry it could be easily and satisfactorily adapted to blood plasma drying.—JANE STAFFORD.

DISEASE CARRIERS

MAN'S nearest zoological kindred, the monkeys and apes, are less dangerous to him as disease carriers than are some of the other, more specialized groups of animals. About the only monkey-borne disease that may be transmitted to man is yellow fever, whereas rodents and hoofed animals bring him a score or more of maladies, was pointed out by William L. Jellison, U. S. Public Health Service bacteriologist, in an address given in Chicago before the meeting of the American Society of Mammalogists.

Man's closest animal friend, the dog, probably the first animal to be domesticated, is carrier for only one disease, although that is a very serious one—rabies. But the placid cow may plague her owner with any of eight kinds of sickness: tuberculosis, anthrax, foot and mouth disease, undulant fever, actinomyces, pox, scarlet fever and streptococcus infection. Other illnesses contractable from hoofed animals include swine erysipelas, trichinosis, glanders and equine encephalitis. Curiously enough, these troubles are all contributed by domesticated hoofed mammals; deer, antelopes and peccaries or wild pigs are not known to carry diseases to human beings.

Rodents and rabbits are bearers of fewer diseases, though some that they do bring us are among the most dangerous of all our ills. The list includes plague, tularemia, spirochaetal jaundice, rat bite fever and one type of food poisoning. Here again it is noticeable that the biggest score is chalked up to the debit of "domestic" rats and mice—although squirrels and rabbits, as carriers of plague and tularemia, can not exactly be rated as innocents.

One striking feature, to which Mr. Jellison attached considerable importance, is the fact that animals with a smaller sum-total of bodily specializations than man and the other primates are of no importance as disease carriers, with the sole exception of the rabies-carrying dog. On the other hand, the more highly specialized animals, including rodents, rabbits and hoofed animals, are also the carriers of the largest number of diseases.

THE ACCURACY OF VEHICLE SCALES

EMPHASIZING the importance of accurate weights and measures in America's defense-time buying, the National Conference on Weights and Measures heard one very cheering report.

Just back from a 48-state tour that has taken over four years is the National Bureau of Standards' 20-ton machine for checking accuracy of vehicle scales. This piece of equipment, technically known as a Vehicle-Scale Testing Unit, has been out inspecting and demonstrating to each state and many large communities how large scales may be inaccurate and what to do about it. Checking the scales that weigh truck loads of bulk commodities has heretofore been too much for most weights and measures officials, who lacked equipment for testing accuracy of such big scales.

State and local officials in all parts of the country enthusiastically received the big scale tester and the two Bureau of Standards scientists in charge, C. F. Horton of the bureau reported to the conference. Fifty thousand questions were asked of scale owners, said Mr. Horton, and they answered more than that in return, about motor-truck weighing and operation of vehicle scales.

Tests with the bureau's equipment showed scale owners that simply because a scale balances perfectly at zero load does not necessarily mean that it will be accurate throughout its weighing range. A surprising number of people had erroneous ideas about this. A wide-spread tendency for wagon scales to be seriously overloaded was discovered. Many scale owners actually believe that a rating "Maximum capacity for motor trucks 12,000 pounds" plainly stamped on the weighbeam means the net, not the gross, load permissible on the scale, when carried in motor trucks. In some scales, erratic performance was traced to construction of the scale. Others proved to be sheltering "livestock" in the scale pits. "We have encountered during pit inspections," said Mr. Horton, "rats, mice, cats, snakes, toads, scorpions, black widow spiders, poultry and in one case a skunk, in scale pits." While easily detected during a test, he pointed out that rats and mice on the lever system might cause considerable error in ordinary weighing. Scales seriously inaccurate because of mud nests that wasps had built inside the main poises were found.

A scale outfitted with a bullet shield of quarter-inch steel plate was encountered in a midwestern state. The state highway patrol, which used the scale to check highway loads, devised this armor for the scale when not in use, because the expensive automatic-indicating mechanism had been a frequent target for rifle or pistol shots fired by persons riding on the highway.

THE USE OF PLASTICS IN AUTOMOBILES

"THE 'plastic car' will be seriously considered if national defense or war priorities should deprive the automobile of its supply of body steel," was stated by George W. Walker, industrial designer of Detroit, speaking before the Society of Automotive Engineers. In fact, such use might have come normally, for, he said, "Plastics have already completely demonstrated that they are logical materials to incorporate to a far greater degree in automobiles."

However, he explained, a "plastic car" at present does not mean one with a body completely of plastic materials. "More than half the body's weight," he stated, "will be due to the steel used as super-structure. However, the plastic panels fastened to the steel framework will cause the body to be far lighter than the all-metal motor car body in use to-day." He also predicated use of windows and windshields of transparent plastic, even more transparent than glass, as well as lighter and less breakable.

"The industrial designer," he said, "especially the one who works closely with the automobile industry—looks forward to the day of the plastic car with genuine anticipation. For in its styling he will have such opportunity to express his art as he has never had before. His opportunities for original expression will be as numerous as the fascinating materials with which it will be his privilege to work. And the plastic combinations which lend themselves to automotive uses are numbered in the thousands.

"After the industry's chemists and engineers have discovered the best means of adapting plastic materials to automobile manufacture and the designer has done his bit, many benefits, I'm sure, will accrue to the maker of the motor car and also to the man who is going to own and operate it.

"For one thing, the plastic car can be lighter than the steel-bodied car—and hence it will cost its owner less to operate it. This, of course, is a decided sales advantage for the manufacturer.

"Then, the car will be quieter. A plastic substance, being an inert material, will insulate against noise far better than steel does. This is another excellent sales point for the manufacturer to use.

"Also, the car can be made more comfortable, for plastics have heat-insulating properties. These substances will keep heat either in or out of a car's interior. And this leads one's imagination to picture truly air-conditioned automobile interiors, automatically cooled in summer and heated in winter. So here's still another possible 'reason to buy' which the manufacturer can stress to his public."

ITEMS

DR. HARLOW SHAPLEY, director of the Harvard College Observatory, has announced that for the third time this year, a new comet has just appeared in the sky. It was discovered on May 27 by H. van Gent, of the Bosscha Observatory at Lembang, Java, according to a cable message received from Dr. W. H. van den Bos, director of the observatory. When found, it was of the eleventh magnitude, too faint to be seen except with a fairly large telescope. It was then in the constellation of the Southern Crown, which can now be seen from the United States very low in the south about 1: 00 A.M., to the left of the hook-shaped figure of Scorpius. Slowly moving in a northwesterly direction, it may come into better view for northern countries, but whether it will brighten or get fainter can not be told until more observations are made. Earlier this year astronomers found two other new comets, as well as Encke's periodic comet. All three departed without being visible to the naked eye in the United States, though one was conspicuous in southern countries.

WET, cool weather in the West is holding back grasshopper outbreaks by delaying their hatching, C. M. Packard, of the U. S. Bureau of Entomology and Plant Quarantine, informed Science Service. Wetness does not do material harm to the egg masses in the soil, but it does prevent them from hatching. If the dampness persists after the young 'hoppers emerge, high mortality can be expected. The grasshopper situation this spring is not as bad as in former years. There are only two extensive areas of severe infestation. The principal one is in the Dakotas, and there is a smaller area extending from southern Nebraska across Kansas and into the Panhandle country of Texas.

FLAXEN cords are strengthening the bonds of good neighborship between the Americas. Peru is the newest South American country to join the ranks of fiber flax raisers, with a crop of about 500 tons now being harvested, according to the U. S. Department of Agriculture. Seed from the United States and Canada has been purchased for next year's sowing. Although considerable flax is now being grown in this country, the domestic crop comes nowhere near supplying the demand, which amounts to as much as 7,000 tons a year. Since most of this came from Europe, there is a wide market for South American replacements in this commodity.

HEREDITY proved stronger than environment, when screw-worm flies whose ancestors had been artifically reared for 100 generations were given a chance to display the behavior normal to their species. When they were removed from the laboratory and released near living animals they buzzed around them at once, seeking an opportunity to lay their eggs. In nature, the flies lay eggs in cuts and scratches in animals' bodies. These hatch into the larvae known as screw-worms, which cause great discomfort to farm animals, as well as considerable money losses to their owners. In the course of a search for chemicals that will drive off the troublesome pests, the Government entomologists reared their hundred generations artificially on a synthetic diet compounded of milk, calf blood, beef and formaldehyde.

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THE SEA LEVEL

SEA level isn't level in the equatorial region of the Pacific Ocean. It is two feet higher on the Australasian than it is on the American side, according to a statement made by Dr. H. U. Sverdrup, director of the Scripps Institution of Oceanography, in his address as president of the Pacific division of the American Association for the Advancement of Science.

As a result of this difference in elevation, there is a narrow, relatively swift, current flowing eastward along the equator. If it were not for the friction of water against water, it would move at a rate of about seven knots. Its actual rate is one or two knots. This, however, is as rapid as the current in a great many inland rivers.

The pile-up of water against the Pacific's western shore results from the action of the trade winds, the speaker stated. Steady winds blowing across the water from the northeast in the northern hemisphere's lower latitudes and corresponding winds from the southeast in the southern hemisphere keep two great currents moving steadily westward in the tropical Pacific. Separating them, in the equatorial belt of calms, is the narrow return current, flowing like a river.

This narrow west-to-east equatorial current, however, accounts for only a small part of the water returned across the Pacific. Much larger streams flow away from the equator, to make the return trip at higher latitudes. In the northern hemisphere, the principal returning mass is borne in the Kuroshio or Japan current, which sweeps along the Aleutian chain and turns southward along the North American coast. It is estimated that this current carries more than 5,000 times as much water as the Mississippi.

As described by Dr. Sverdrup, the Pacific is a cold monster with a relatively thin, warm skin. Surface temperatures are quite high, reaching as much as 75 degrees Fahrenheit. But this warm surface layer extends downward only a few hundred feet at most. The great bulk of Pacific Ocean water, in the depths, is always cold, most of it only a few degrees above freezing-point.

A NEW SYSTEM FOR MOTION PICTURE PHOTOGRAPHY

DISTANT and near-by objects or actors may be photographed equally sharply at the same time in motion pictures or television with a new method. The invention has been granted U. S. Patents 2,244,687 and 2,244,688, assigned to I–R System, Inc., of New York City.

Photographers know that when a camera lens is focused on a subject close to the camera, objects far away are out of focus. If the distant object is made sharp, the near ones are blurred. By making the diaphragm opening of the lens small, "depth of focus" may be increased, but this requires considerably more light.

The new system, invented by Dr. Alfred N. Goldsmith, television and sound motion picture engineer, Harry R. Menefee, William Mayer and Fritz Kastilan, achieves the same effect with any kind of lens, working at full opening. It can be used, the patent states, in motion picture photography or television wherever lighting conditions are subject to control. It is not suitable for out-of-door photography.

The set is illuminated by several groups of lights. One, for instance, may light the foreground, another the middle distance and another the background. These are flashed on and off consecutively, so only one section receives light at any particular instant. During exposure of each frame of motion picture film, however, the set is completely lighted.

Ordinary focusing is accomplished by moving the lens in and out. Near the film, distant objects are focused, and to make near-by objects sharp, it has to be pulled out. While the lights are flashing, the lens might move in step with them. It could be arranged to focus the foreground when that part was lighted, then the middle distance when the light was shining there, and then the background. The patent suggests such a movement of the lens in synchronism with the lights as a possibility, though it has disadvantages. Sound films are taken at 24 pictures a second. Therefore, if the set had three sections, the lens, moved three times for each picture, would have to be started and stopped 72 times each second.

It is also possible to change the focus of a fixed lens by inserting flat pieces of glass of different thicknesses behind it. The patent refers to such a device as a differential focuser, or a "diffo." Diffos of different thicknesses are mounted on a disk, which turns in the path between the lens and film, thus changing the focus without any vibrating movement. This disk is turned by a synchronous motor, which also controls the changes of illumination. Other kinds of diffos can be used, it is said, based on differences in color, or on the polarization of light.

In the Orson Welles feature picture, "Citizen Kane," many scenes show near-by and distant characters in focus, an effect which has been used very dramatically and has caused much favorable comment. This, however, was not done with the new method, but by the use of short focus lenses, very small diaphragm openings and extremely bright lighting.—JAMES STOKLEY.

OLD PHOTOGRAPHS SHOWING RATE OF TREE GROWTH

OLD photographs can be of value to botanists and foresters in studying the rate of new growth that heals up old scars left in the forests by fires long ago. Such a series, taken at intervals from 1872 to the present time, has been studied by Ronald L. Ives, of Fort Worth, Kansas, as a by-product of several geological field trips into the high country of Colorado. One particular area was burned over during the Indian troubles of 1862–63. In a few places the soil itself was burned away, down to bedrock.

In 1872 came the pioneer photographer, William H. Jackson, accompanying the Hayden geological expedition

as official picture-maker. His photographs, still extant, show the dead trees bare and barkless, with grass growing among their trunks.

The next series of photographs was taken in 1878. The grass was then being crowded out by a dense growth of mixed shrubs. After that there was a lapse of 20 years during which there is no existing photographic record. For the decade 1898–1908, however, there are abundant photographic records, which show the shrubs yielding place to the next stage in succession, an aspen forest. Maximum density of the aspen was reached in 1915.

As early as 1900 new conifer growth was showing itself here and there, and by 1920 the evergreens were beginning to overtop the aspens in many locations. Photographs taken about 1920 show the evergreens beginning to assert dominance. In some locations they covered 40 per cent. of the area. By 1935, the evergreen percentage had risen to 65, and in 1940 dominance was complete, with only scattered patches of aspen here and there, where growing conditions had not been favorable for the conifers.

Mr. Ives figures a replacement schedule for the region as follows: Maximum brush growth, 25 years; maximum aspen, 40 years; aspen largely eliminated, 65 years; complete elimination of fire scar, 300 years or more.

DIET OF FOXES AND FISH

ALLOWED to over-indulge in a diet of raw fish, both foxes and fish were observed to develop spontaneously a disease identical with the alcoholic disease caused in man by lack of thiamin (vitamin B_1), was reported at the meeting of the American Neurological Association at Atlantic City. Dr. Leo Alexander, of Boston, and his associates, Drs. Robert G. Green, C. A. Evans and Louis E. Wolf, stated that both the foxes and the fish can be cured of their trouble by the vitamin.

The human disease, known as Wernicke's disease, has been produced experimentally in animals by Dr. Alexander and other colleagues when they fed them a diet deficient in vitamin B_1, but over-abundant in other vitamins, particularly riboflavin, nicotinic acid or vitamins A and D. The excess of the other vitamins, they concluded, had so raised the vitamin B_1 needs that the resulting deficiency was greater than it would have been otherwise.

What happens to the blood chemistry in thiamin deficiency or Wernicke's disease, was described to the meeting by another group: Drs. Herman Wortis, Norman Jolliffe, Martin H. Stein and Ernest Bueding. In both these conditions, the blood's pyruvic acid is invariably increased.

When normal individuals are fed glucose, the blood pyruvate is increased, but returns to normal within three hours. In Wernicke's disease this increase is very high and the return to normal is delayed. Feeding thiamin to the patient brings the blood chemistry back toward normal. Although Wernicke's disease is always associated with lack of thiamin, these observations indicate that it is also due to lack of other nutritive essentials.—MARJORIE VAN DE WATER.

THE INTRODUCTION OF FOREIGN PLANTS

FLORIDA is trying its hand at growing some of the foreign specialty imports that war conditions have cut off.

Crops which the State Experiment Station at Gainesville, Fla., advises as "worthy of trial plantings," though not yet established certainly enough for extensive production, include these:

French endive, formerly imported from France and Belgium. The Everglades area is trying this vegetable. It is believed likely to be successful.

Tomato paste, formerly imported in quantity from Italy, and made from special, small varieties of tomatoes. "Paste" types of tomatoes are being investigated by several Florida growers.

Sage for seasoning, formerly brought in quantity from Greece. Various sections of Florida are trying this.

Paprika from various Balkan countries. Planted in trials at the Experiment Station farm, paprika gave excellent results. Florida had not yet produced this plant commercially, but Louisiana, South Carolina and California have.

Spinach seed from Holland and Denmark. One seed grower in Florida is already raising 100 acres of spinach seed.

Mustard and turnip seed from Japan. These, it is believed, can be grown in Florida.

Teasel burrs from France. Considered especially good for combing wool in American mills, the French type of teasel is to be planted on the Experiment Station Farm at Gainesville for trial.

FARM WEALTH IN WEEDS AND WILD PLANTS

FARMERS of the future may win wealth from wild plants that are now regarded only as weeds, was suggested by Wheeler McMillen, president of the National Farm Chemurgic Conference, in an address at Nashville, Tenn., before the first annual Southern Chemurgic Conference.

Reminding his hearers that there are about 250,000 known species of plants in the world, of which approximately 15,000 are native to the United States, the speaker called attention to the fact that the ones under cultivation number only a few scores, and those are mainly the same as our prehistoric ancestors chose because they could be used just as nature produced them. In modern times great changes have been made in cultivated plants by scientific breeding, yet we have not thought to pick up hitherto uncultivated plants and develop their good qualities in the same way. He urged the appropriation of funds for research in this direction, to be conducted at state experiment stations.

Mr. McMillen also called for a renewed drive toward greater national self-sufficiency, in the interests of defense. Introducing new crops with this in view will also benefit the farmer, he pointed out, because it will then be possible to decrease the acreage now devoted to production of burdensome surpluses.

"By producing fewer of the things of which we have too much, and more of the things of which we have not

enough, a more stable economy can be obtained,'' he said. ''A stable economy with a high rate of productivity makes for domestic prosperity.''

UNFARMABLE LAND

FELLING forests to create new farms, traditional practice in America since earliest time, isn't always the right thing to do, according to Dr. J. Alfred Hall, of the U. S. Forest Service, speaking at the Chemurgic Conference. Rather, the process should be reversed on much land which is now being unprofitably plowed year after year, with the farmers only sinking themselves and their families deeper and deeper into poverty.

Dr. Hall took the states of Tennessee and Kentucky as examples for his thesis. When the first settlers came, both states were practically continuous forest. The newcomers ravaged the woods with fire and ax, with no thought for the timber values but only for the soil they could plow and plant after the trees had been cleared.

The result, he said, is that in both states the cut of high-grade lumber is diminishing, with the proportion of lower grade lumber increasing. Men who used to have jobs in sawmills and other wood-using industries have been thrown out of work. Where oak, hickory, chestnut and gumwood used to be a source of pride as well as revenue, there is now a shortage so severe that hardwood lumber is even having to be brought in from the outside.

Dr. Hall demanded action, and action now: ''Lands that ought not be farmed, and on which the forest has been so degraded that private capital will not carry the load of investment necessary to their regeneration, ought to be in public ownership. Federal, state, county or municipal—why quibble? Get it done. Protect and preserve the forests in order that people may work and produce goods. These things are not undemocratic. They are the essence of democracy: the applied will of the people that they may live happy, prosperous, dignified lives on a stable resource base. Dictatorships grow and thrive on ruined lands and ruined people; democracies live where people have jobs and enough to eat. We can run this country so that democracy need never be threatened, but sometimes I wonder if we have done so. The people themselves must will to do the job.''

ITEMS

RESULTS obtained with a new type of instrument for observing the fiery clouds of prominences in the sun's atmosphere were announced recently by Dr. Edison Pettit, of the Mount Wilson Observatory, at a meeting of the Astronomical Society of the Pacific. When attached to a motion picture camera prominences have been photographed moving with velocities exceeding 180,000 miles per hour. Prominences are visible to the naked eye only for a few minutes during a total eclipse of the sun. Otherwise they are visible only with expensive apparatus or simpler devices used at high altitudes. The new instrument, which makes use of polaroid and has no moving parts, can be used with a small telescope at any elevation. Dr. Pettit stated that ''with the new instrument scarlet flames stood out in the atmosphere of the sun with remarkable sharpness, resembling a prairie fire.''

THERE need be no fear of lightning when riding in an automobile with a modern steel body and top. Proof of this was given at the Westinghouse high voltage laboratory at Trafford, Pa., when Dr. Gilbert D. McCann sat in such a car while being bombarded with 3,000,000 volts of artificial lightning. ''Although the laboratory lightning stroke hit the car just six inches above my head,'' said Dr. McCann, ''I was safe from injury because modern steel car bodies are effective shields against lightning.'' Even the rubber tires produce no difficulty, for the lightning jumps over them from the metal wheel to the ground. In an actual storm, with the road and tires wet, the conduction of the current from the car in this way would be aided. Dr. McCann said also that the gasoline tank presents no serious hazard. The protected position of the tank is one that lightning can hardly reach. It seeks its nearest target, usually the top of the car.

A NEW disease of cherry trees, which causes a loss of green color along the leaf veins and a general mottling of leaf surfaces, has been detected by S. M. Zeller and A. W. Evans, of the Oregon Agricultural Experiment Station at Corvallis. They report their findings in the current issue of *Phytopathology*. Prunes as well as cherries, both important commercial crops in the Pacific Northwest, are attacked. The disease has also been found on ornamental flowering cherry trees, on Italian prunes and on several species of wild cherry. The cause has been identified as a virus, which can be transmitted along with grafts from diseased stocks.

RESEARCHES on bacteria that will enable more accurate classification into species have been reported by Dr. N. R. Smith, of the U. S. Department of Agriculture. Bacteria are exceedingly difficult to classify by the ordinary methods applied to other living organisms, because they are so exceedingly small and look so much alike. Dr. Smith and his associates are making use of hitherto neglected aspects of bacterial behavior and physiology in determining differences between seemingly similar forms. By culturing them under unfavorable conditions, they obtain abnormal growths, and they have found that sometimes abnormalities will disclose specific relationships when normal growth does not. Bacteriophages have also been found useful in this work of classification, for some strains are resistant to a given bacteriophage that readily kills other, similar-appearing bacteria.

IOANA, a wilt-resistant golden hybrid sweet corn, developed by E. S. Haber, research horticulturist at Iowa State College, has consistently outyielded ordinary Golden Bantam from 60 to 80 per cent., often actually doubling the weight of ears per acre. In the last three years it has set similar yield records as far east as Maryland. The hybrid is resistant to bacterial wilt, a disease which often causes great damage to Golden Bantam and other susceptible varieties. It is also resistant to smut. The new variety can be grown from coast to coast in the northern part of the United States, and has been grown successfully in Texas, Louisiana and some of the other southern states.

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PAPERS READ BEFORE THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The Mt. Palomar Telescope

COMPLETION of the great 200-inch telescope to be erected on Mount Palomar as part of the department of astrophysics of the California Institute of Technology is at last in sight, thirteen years after the late Dr. George Ellery Hale convinced the Rockefeller Boards of the feasibility of such an instrument and obtained funds for its construction.

This was announced by Dr. Max Mason, chairman of the Observatory Council, speaking before the Pacific Division of the American Association for the Advancement of Science and the Astronomical Society of the Pacific. He reported that the difficulty caused by a sagging of the great disk of glass for the big mirror which will collect and concentrate the light of distant stars, had been overcome.

The disk, which is 17 feet in diameter and originally weighed 21 tons before some four tons of glass were removed in grinding, is solid in front, but the back is ribbed, mainly to lighten it. By a system of 36 levers, the mirror is held in the holes formed between these ribs. Both the method of support and the structure of the mirror are new in this instrument.

"The supporting system must operate so perfectly that no bending of the reflecting surface beyond one or two millionths of an inch will occur as the telescope moves. As the surface of the mirror was brought by polishing close to a spherical form it became clear that the disk, when tipped from the grinding table to a vertical position for optical test, sagged slightly under gravity. After months of study, as the polishing continued, this sag was eliminated by installing a system of twenty-four squeeze levers, operated by counter weights, distributed around the rim of the glass."

Dr. Mason announced that the mounting of the great telescope on Palomar Mountain is now completed. After five years work on the mirror in Pasadena, more than four tons of glass have been removed. It has nearly reached the spherical surface which it must have before it is changed to a paraboloid by deepening the center concavity five thousandths of an inch. It is doubtful, he stated, whether the new instrument will be useful for photographing moon or planets, due to shakiness of the air, which destroys detail. Instead it will be used to study faint and distant galaxies and to analyze into high detail light received from stars and planets.

When the 200-inch telescope finally does swing into use, one of its employments will be the study of radiations from the planets, was reported by Dr. John Strong. Planets not only reflect visible light which they receive from the sun; they absorb and then re-radiate considerable quantities of solar energy, largely in the form of the invisible infra-red rays. These will be caught by the great mirror and analyzed in a number of specially constructed instruments.

These instruments are now being constructed and the special techniques necessary for their operation are being developed by members of the institute staff. Much of the information necessary for comparison of conditions on the planets with those on the earth can be obtained only by a more careful and exact study of physical processes taking place on our own planet's surface and in its atmosphere. Determinations, on an entirely new order of exactness, of what happens to earth radiations when they pass through water vapor, carbon dioxide, ozone and the major atmospheric gases, are on the program of research. Incidentally, Dr. Strong pointed out, data obtained in these researches will probably have considerable value to meteorologists as well as to astronomers.

The Metal Cadmium

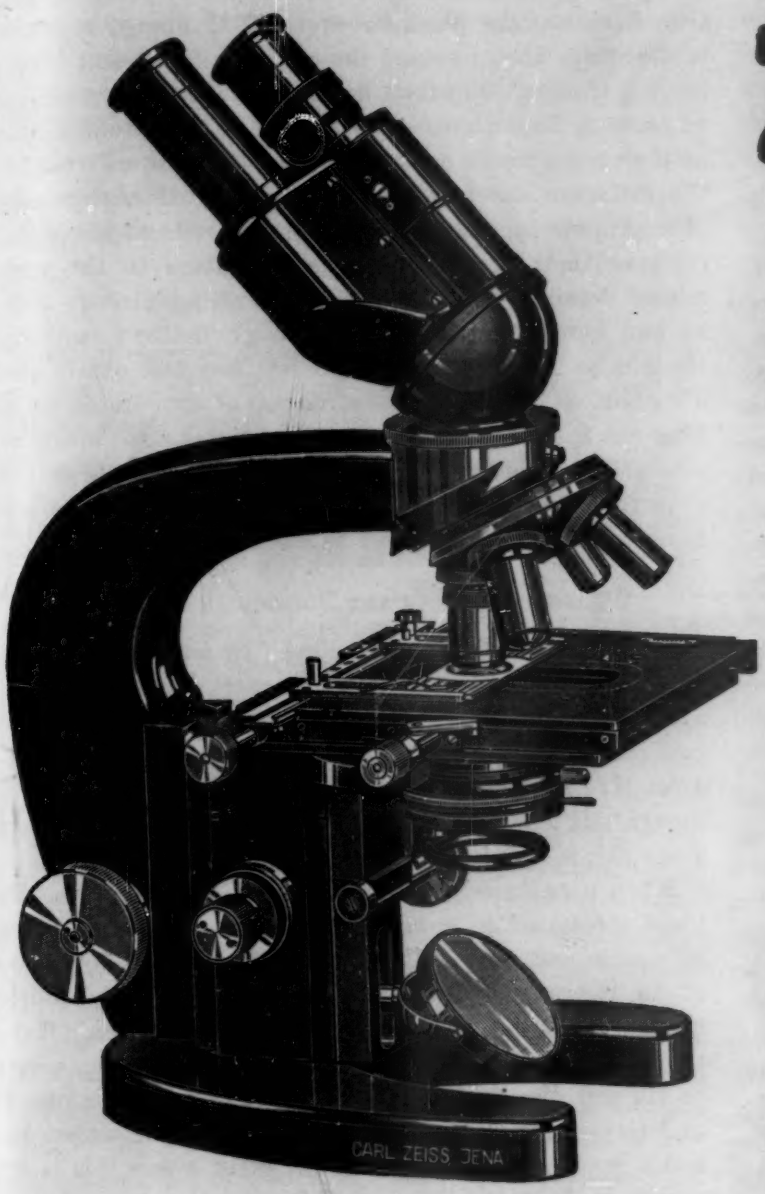
A FORM of the metal cadmium which gives off radium rays and lasts many weeks is the latest product of modern alchemists who turn one kind of matter into another. The radioactive cadmium is made by bombarding silver with deuterons, or atomic bullets, from the cyclotron, was announced at the meeting of the American Physical Society, meeting with the Pacific Division, by Dr. A. C. Helmholz, of the University of California. Although radioactive forms of all the elements have been made in this way, most of them quickly decompose, in a matter of minutes or even seconds. The cadmium, however, is relatively long-lived. At the end of about 158 days, Dr. Helmholz finds that half the original amount will remain.

Swing of Light Beam

In many scientific instruments, the indication is by a weightless light beam pointer. That is, a mirror on the instrument swings, and the beam of light reflected from it moves to indicate the value being measured. To record such a moving beam, it is allowed to fall on a moving band of sensitive photographic paper. However, such a record may now be made directly with a pen, using a device described to the meeting by D. J. Pompeo and C. J. Penther, of the Shell Development Company, Emeryville, Calif. This has the advantage that the record is obtained without having to develop the photographic paper. What are essentially two photocells, or "electric eyes," are mounted on a moving carriage, which carries the pen. When the light on the two photocells is the same, the carriage is stationary. But as soon as the light swings, one cell receives more than the other, and motors are operated to move it until they are again equally illuminated. In this way the pen follows the light beam, and the pen writes its record on a moving strip of ordinary paper.

Spring Growth in Sea Pastures

Spring is the time of most rapid growth in the pastures of the sea as well as in the pastures ashore, it appears from observations on the waters off the coast of California, was reported by Professor W. E. Allen, of the Scripps Institution of Oceanography. The minute one-celled plants known as diatoms, which are the ultimate food of all sea creatures, tend to reach maximum abundance dur-



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ing the second quarter of the year. Warmth in itself seems not to favor these plants, for in years when the water has been warmest, as in 1926 and 1931, production of this "grass of the sea" has been very poor.

Sea Winds Trim Trees

Winds from the sea can trim trees well inland, giving them the distorted, fantastic shapes most often seen on dunes and rocky shores, was described by Professor R. W. Richardson, of San Diego State College. Golden Gate is a great wind-gap as well as a great doorway of commerce, for sea winds pour in through this opening in the coastal range and spread far into California's inland valley. Before the coming of white men, this valley was fully wooded, but even in early Spanish days axe and fire began their work, and now it is principally an area of farms and open pastures. Individual trees in the valley have their forms changed drastically by the persistent strong winds that are now free to blow over the denuded landscape. Professor Richardson supported the theory that such wind-blown forms in trees are produced mainly by simple mechanical effects, rather than by salt particles carried in the wind or by greater evaporation on the windward side.

The Mysteries of Living Cells

Secrets of the structure and functioning of the parts of the cells of which all living plants and animals are made may be revealed by use of the electron microscope, which shows details far finer than can be detected with the old-style light microscope.

Speaking in Pasadena at a symposium on the electron microscope, held by the American Physical Society, meeting with the Pacific Division, Dr. A. Marshak, of the University of California, told of some of the biological problems that the new instrument may solve.

"The cell, which is the structural unit of the higher organisms, is itself a highly organized body," he said. "At its surface is a membrane which determines which molecules and ions of the surrounding medium will enter the cell body. It is known to be very selective in its permeability to simple ions. The biologist would like to know whether it has a reticulate or porous structure, whether it has a uniform thin lipoid surface or whether it is emulsoid. Different types of indirect evidence have suggested all of these possibilities. What is obviously needed is direct observation."

Other details, too, may be brought out. One of these may tell more about the very important process by which plant cells, with the influence of sunlight, convert carbon dioxide and water into carbohydrates, which are foods for man and beast. Chlorophyl, the green coloring matter of plants, does not show this process, called photosynthesis when in solution. It does so in plant cells, where there are chlorophyl-containing bodies called plastids. "A knowledge of the molecular structure and organization of the plastid may go far in helping us to determine what the photosynthetic unit really is and to understand the photosynthetic process itself."

Industrial Research

Many industrial applications of the electron microscope have already been found, and others are in prospect, Dr. Otto Beeck, of the Shell Development Company, reported to the symposium. Among those he mentioned are: "The investigation of industrial dust and smokes is a problem of sanitary importance.—Knowledge of the actual shapes of the photographic grains and how they are affected by the different developers will possibly revolutionize the photographic industry.—Producers of artificial fibers can compare their product with neutral fibers to the most minute details.—The colloid chemist will see directly what he had heretofore to deduce through indirect methods. He will be able to measure particle size and obtain size distributions directly.—The structure of evaporated metal films can be investigated and of late it looks as though we soon shall be able to obtain pictures of the minute details of metal surfaces without the necessity of preparing specimens which are transparent to electrons."

"Tagged" Atoms and Biological Research

How chemical elements "tagged" by making them artificially radioactive with atomic-particle bombardment in a cyclotron are being used in biological research and in medical treatment was described at the meeting by Dr. John H. Lawrence, of the University of California. Although this new tool of research is only about half-a-dozen years old, it is being extensively used.

When a radioactive atom has been introduced into the blood stream of an animal or the sap stream of a plant, its course and final lodgment can be followed by means of an instrument called a Geiger counter, which clicks whenever one of the radioactive particles given off by the atom passes through it. Formerly it was necessary to kill and dissect the animals before testing their organs and tissues for the presence of these tagged atoms, but technique has been improved to a point where this is not necessary in many cases. This Dr. Lawrence demonstrated by holding a Geiger counter over the thyroid gland of a colleague who some time before had drunk a "cocktail" of a radioactive iodine compound.

Conspicuous among possible medical uses of artificially radioactive substances is the treatment of cancer and several other diseases by means of radioactive phosphorus. It has been discovered that tumor cells absorb much more phosphorus than do healthy cells. At the same time, it has long been known that such diseased cells are very sensitive to radiations. By giving doses of radioactive phosphorus, the anarchistic cells of malignant tumors are in effect induced to commit suicide, for they eagerly absorb the phosphorus and are then killed by its radiation.

Vitamin B_1 and Plant Disease Control

The story of a vitamin experiment that backfired was told to plant pathologists attending the meeting, by Dr. Dean E. Pryor, of the U. S. Department of Agriculture. He undertook to test a theory that if cantaloupe vines were given doses of vitamin B_1 they would acquire extra vigor and thus become resistant to the troublesome fungus disease known as powdery mildew. Under both greenhouse and field conditions, the vitamin seemed, if anything, to impart more vigor to the fungus than it did to the vines. From these preliminary results, he concluded, it would seem that the vitamin "offers little possibility

for control of cantaloupe powdery mildew.'' More hope would seem to be found in breeding and selection of strains resistant to the disease, for in experiments which Dr. Pryor carried on jointly with Dr. Thomas E. Whitaker, also of the Department of Agriculture, a number of plants were found that showed no gross signs of the mildew, even in the midst of plantings that were heavily infested. Further search for resistant strains is still going on.

ORANGE TREES AND VITAMIN B_1

Healthy valencia orange trees, grown under favorable conditions, failed to show any improvement from good to superior when vitamin B_1 and nicotinic acid were added to soil and irrigation water. This was the report of Dr. E. R. Parker and Dr. F. M. Turrell, of the Citrus Experiment Station, and Dr. James Bonner, of the California Institute of Technology, on experiments carried on at Riverside.

Young trees were planted in good soil, well drained and aerated. At the time of planting organic matter in the form of peat and dairy manure was added to the fill-in soil and as a surface mulch; the usual procedure. As the trees grew, vitamin B_1 and nicotinic acid, another factor in the vitamin B complex, were added generously to the irrigation water continually throughout two seasons. Now vitamin B_1 can do remarkable things for humans deficient in the substance. It also stimulates growth in some plants. But healthy young valencia orange trees, according to the scientists, apparently have no use for vitamin B_1 or nicotinic acid.

''It appears,'' they said, ''that vigorous young valencia trees synthesize sufficient vitamin B_1 for their own needs. The vitamin B_1 content of the mature leaves was not affected by any of the soil treatments. In all cases it was higher than that of species of plants which responded to treatment with vitamin B_1. The beneficial effects of the organic matter applied to newly planted trees appears to be due to factors which were not limiting in these experiments.''

ITEMS

A SPOT in the ocean, centered between Iceland, Greenland and Newfoundland, was severely jolted on its underlying sea bed on June 18, by a strong earthquake shock. As determined by the U. S. Coast and Geodetic Survey on the basis of data collected by Science Service, the epicenter was in latitude 52 degrees north, longitude 52 degrees west. This puts it about 900 miles northeast of Newfoundland, 900 miles southwest of Iceland, and 750 miles southeast of the tip of Greenland. The quake began at 6:09 A.M., Eastern Standard Time. Seismological stations furnishing telegraphic data were those of St. Louis University, Georgetown University, the Dominion Observatory at Ottawa and the U. S. Coast and Geodetic Survey at Tucson, Ariz.

DROUGHT relief came last week to the Southeast, with a spread of the rains that had already ended the anxieties of the farmers in all except the extreme tip of the Northeast, the U. S. Weather Bureau reports. More rain, however, would be helpful; there is still a considerable moisture deficit for the season. Farther west, excessive wetness continued. Farmers in the southern part of the Wheat Belt, from Texas to Kansas, began harvest under difficulties. Cornfields in the Southwest have become troublesomely weedy because of the impossibility of getting cultivators into the muddy fields. Last week was a week of low temperatures generally, with nothing above 90 degrees reported north of Virginia, Tennessee and northern Louisiana. There was even a little frost in the northern Great Lakes region.

A NEW model, graphically depicting the great submarine canyon that gashes the ocean bottom off the mouth of the Hudson River, has been placed on display at the American Museum of Natural History. This canyon, 50 miles long and with a depth comparable to that of the Grand Canyon of Arizona, will be invisible to human sight as long as the ocean lasts, yet modern echo-sounding methods have made it possible to learn its topography in great detail. The new relief model, constructed under the direction of Dr. Harold E. Vokes of the museum staff, is eleven feet long and three and one half feet wide. It represents an area 164 miles long and 53 miles wide.

STRATOSPHERE conditions of low atmospheric pressure and great cold are duplicated in a three-foot-square cabinet known as a ''flight similitude chamber,'' developed by a University of Chicago meteorologist, Dr. Michael Ference, Jr. The apparatus will be used in training weather observers for service in military and civil aviation, as well as in calibrating the radiosonde instruments carried up into the stratosphere by small balloons to record conditions there and report them back to earth by means of robot radio sets. In the laboratory, the radiosonde instruments are placed in the flight similitude chamber. A vacuum pump partially exhausts the air, while a combination of dry ice and alcohol evaporation reduces the temperature. The radiosonde faithfully reports the changing conditions to the listening students, while an instructor checks accuracy of their interpretations. Conditions duplicating those of 20 miles above the earth's surface, with atmospheric pressure reduced to one per cent. of normal and temperature at 100 degrees below zero Fahrenheit, have been produced in the laboratory with the new apparatus.

THE mystery of the suppressed mathematical tables—that is a problem for which an answer is sought by E. H. Neville, of the University of Reading. The tables in question were prepared by James W. L. Glaisher, mathematician of Cambridge University, who died in 1928 at the age of eighty years. He seems to have had the curious habit of preparing tables of mathematical functions of various kinds, tools of great value in many kinds of scientific work, and then, despite the great labor expended, keeping them hidden. One of these was a table of squares, cubes and other powers up to the twelfth of the numbers from one to 1,000. ''This table,'' writes Mr. Neville in a communication to *Nature*, ''was finished in 1873 and was stereotyped, but it was not published. The plates were presumably destroyed, and the proofs seem to have been systematically hunted down; one copy survived in secret.'' This copy was used as the basis for a Table of Powers just published by the British Association for the Advancement of Science.

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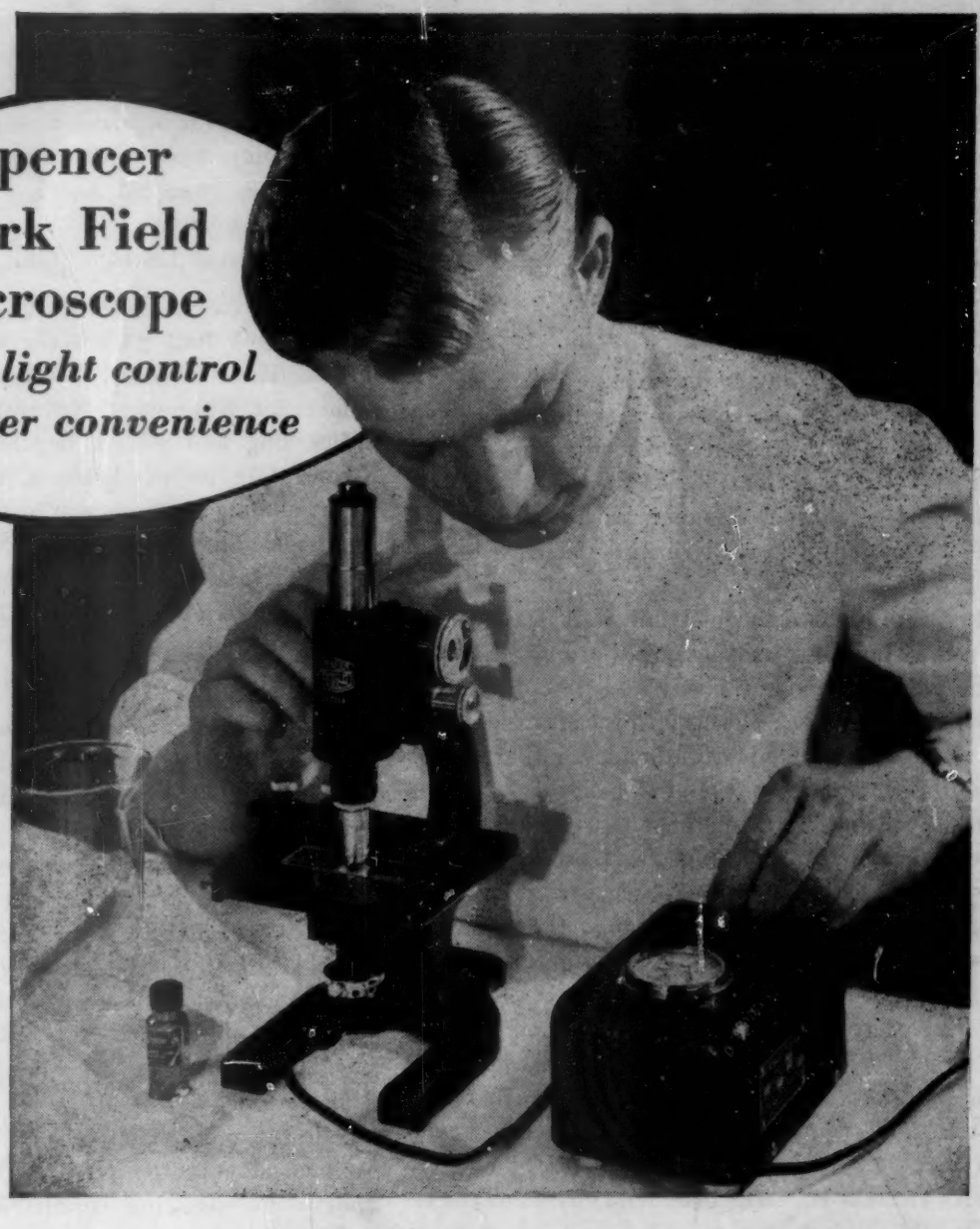

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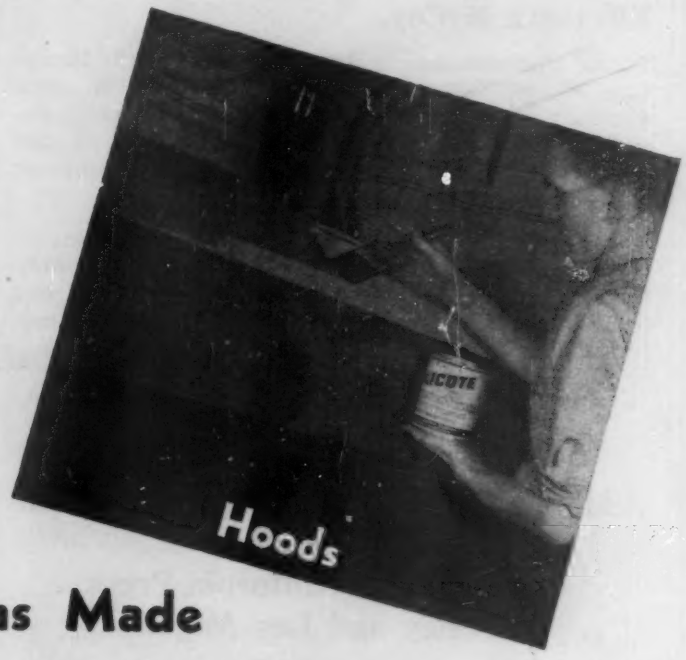

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4. VIRTUE, R. W., and DOSTER-VIRTUE, M. E.: *J. Biol. Chem.*, 128:665:1939.

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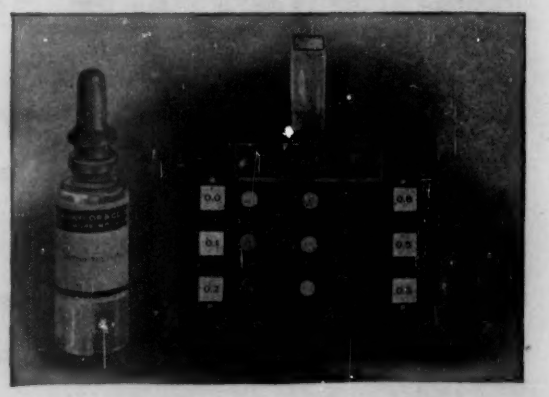

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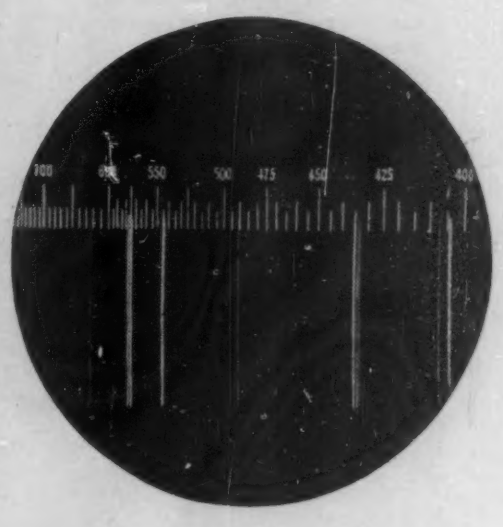

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